FINAL – Revision 1

May 29, 2008

PHASE II
SAMPLING AND ANALYSIS PLAN
FOR OPERABLE UNIT 3
LIBBY ASBESTOS SUPERFUND SITE

Part A: Surface Water and Sediment

Prepared by
U.S. Environmental Protection Agency
Region 8
Denver, CO

With Technical Assistance from:

Syracuse Research Corporation
Denver, CO

and

NewFields Boulder LLC
Boulder, CO

APPROVAL PAGE

Part A of the Phase II Sampling and Analysis Plan for Operable Unit 3 of the Libby Asbestos Superfund Site has been prepared by the U.S. Environmental Protection Agency, Region 8, with technical support from Syracuse Research Corporation and NewFields Boulder LLC, and is approved without conditions.

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6/3/08
Date

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DOCUMENT REVISION LOG

Revision	Date	Primary Changes
0	03/20/08	--
1	05/29/08	Make document corrections Add field and laboratory QC results for surface water and sediment (Attachment A.2) Update Section 6 to reflect rapid turn-around analysis requirements Update Section 7 to reflect input from the toxicity testing laboratory Add new field SOPs (Attachment B) Add applicable Libby-specific laboratory modifications (Attachment C)

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LIST OF ACRONYMS

AOC	Administrative Order on Consent
CAR	Corrective Action Request
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain-of-Custody
CSF	Close Support Facility
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EDXA	Energy Dispersive X-Ray Analysis
EPA	U.S. Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
FS	Feasibility Study
FSDS	Field Sample Data Sheets
FSP	Field Sampling Plan
FTP	File Transfer Protocol
GC/MS	Gas chromatography/mass spectroscopy
GO	Grid opening
GPS	Global Positioning System
GSD	Geometric Standard Deviation
HASP	Health and Safety Plan
HQ	Hazard Quotient
ICV	Initial Calibration Verification
ID	Identification
IL	Inter-laboratory
ISO	International Organization for Standardization
IS	Internal Standard
KDC	Kootenai Development Corporation
LA	Libby Amphibole
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MCE	Mixed Cellulose Ester
MCL	Maximum Contaminant Level
MDEQ	Montana Department of Environmental Quality
MFL	Million fibers per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NVLAP	National Voluntary Laboratory Accreditation Program
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDF	Portable Document Format

LIST OF ACRONYMS (cont.)

PE	Performance Evaluation
PLM	Polarized Light Microscopy
PLM-VE	Polarized Light Microscopy Visual Area Estimation Method
PLN	Poisson lognormal
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QATS	Quality Assurance Technical Support
QC	Quality Control
RD	Recount Different
RF	Response Factors
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RS	Recount Same
RSD	Relative Standard Deviation
SAED	Selective Area Electron Diffraction
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TEH	Total Extractable Hydrocarbons
TEM	Transmission Electron Microscopy
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons

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PHASE II
SAMPLING AND ANALYSIS PLAN
FOR OPERABLE UNIT 3
LIBBY ASBESTOS SUPERFUND SITE

PART A: SURFACE WATER AND SEDIMENT

1.0 PROJECT OVERVIEW

1.1 Purpose of this Document

This document is Part A of the Phase II Sampling and Analysis Plan (SAP) for the collection and analysis of samples of environmental media to support a remedial investigation/feasibility study (RI/FS) within Operable Unit 3 (OU3) of the Libby Asbestos Superfund Site near Libby, Montana. OU3 includes the property in and around the former open pit vermiculite mine that is located northeast of the community of Libby, as well as the geographic area surrounding the former vermiculite mine that has been impacted by releases and subsequent migration of hazardous substances and/or pollutants or contaminants from the mine, including ponds, Rainy Creek, Carney Creek, Fleetwood Creek, and the Kootenai River. Rainy Creek Road is also included in OU3. The exact geographic area of OU3 has not yet been defined but will be based primarily upon the extent of contamination associated with releases from the former vermiculite mine as determined in the remedial investigation (RI) of OU3. The purpose of Part A of the Phase II SAP for OU3 is to guide the collection of data on mining-related contaminants in surface water and sediment in streams and ponds to assess the impact of releases from the mined area. The complete scope of Phase II is expected to include collection of data on other environmental media of potential concern in OU3. Requirements will be described in subsequent parts of the Phase II SAP for OU3. These data will be used to support an RI of OU3, the goal of which is to characterize the nature and extent of mining-related contamination in OU3, and to characterize the nature and level of risk posed by mining-related contamination to human and ecological receptors in OU3.

This SAP contains the elements required for both a field sampling plan (FSP) and quality assurance project plan (QAPP). This SAP has been developed in accordance with Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA 2001) and the Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4 (EPA 2006). The SAP is organized as follows:

Section 1 – Project Overview
Section 2 – Background and Problem Definition
Section 3 – Summary of Phase I Data

Section 4 – Data Quality Objectives
Section 5 – Sampling Program
Section 6 – Laboratory Analysis Requirements
Section 7 –Site-Specific Toxicity Testing requirements
Section 8 – Quality Control
Section 9 – Data Management
Section 10 – Assessment and Oversight
Section 11 – Data Validation and Usability
Section 12 – References

1.2 Project Management and Organization

Project Management

EPA is the lead regulatory agency for Superfund activities within OU3. The EPA Remedial Project Manager (RPM) for OU3 is Bonita Lavelle, EPA Region 8. Ms. Lavelle is a principal data user and decision-maker for Superfund activities within OU3.

The Montana Department of Environmental Quality (MDEQ) is the support regulatory agency for Superfund activities within OU3. The MDEQ Project Manager for OU3 is Catherine LeCours. EPA will consult with MDEQ as provided for by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan, and applicable guidance in conducting Superfund activities within OU3.

EPA has entered into an Administrative Order on Consent (AOC) with Respondents W.R. Grace & Co.-Conn. and Kootenai Development Corporation (KDC). Under the terms of the AOC, W.R. Grace & Co.-Conn. and KDC will implement this SAP. The designated Project Coordinator for Respondents W.R. Grace & Co.-Conn. and KDC is Robert Medler of Remedium Group, Inc.

Technical Support

EPA will be supported in this project by a number of contractors, including:

- Syracuse Research Corporation (SRC) will assist in the development of sampling and analysis plans, in the evaluation and interpretation of the data, and preparation of the baseline risk assessments for OU3.
- NewFields Boulder LLC, working as a subcontractor to SRC, will provide support in development of sampling and analysis plans, evaluation and interpretation of data, mapping and other GIS applications, and design and evaluation of the feasibility study.

Field Sampling Activities

All field sampling activities described in this SAP will be performed by W.R. Grace & Co.-Conn. and KDC, in strict accord with the sampling plans developed by EPA. W.R. Grace & Co.-Conn. and KDC will be supported in this field work by MWH Americas, Inc. (MWH). Individuals responsible for implementation of field sampling activities are listed below:

- MWH Project Director: Michael DeDen
- MWH Project Manager: John D. Garr
- MWH Field Quality Control Officer: Mark Rettmann
- MWH Quality Assurance Officer: Stephanie A. Boehnke

On-Site Field Coordinator

Access to the mine is currently restricted and is controlled by EPA. The on-site point of contact for access to the mine is Courtney Zamora of the U.S. Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe).

Sample Preparation and Analysis

All samples collected as part of the Phase II investigation will be sent for preparation and/or analysis at laboratories selected and approved by EPA.

- All analyses of samples for asbestos will be performed by EMSL Analytical, Inc.
- All analyses of samples for non-asbestos analytes will be performed by Energy Laboratories, Inc. (ELI)
- All samples of soil or soil-like media to be analyzed for asbestos will be prepared for analysis by EPA's soil preparation facility (referred to as the close support facility, CSF) in Denver, CO, operated by CDM.
- All validation and verification activities for asbestos and non-asbestos data will be performed by SRC or their subcontractors.

Data Management

Administration of the master database for OU3 will be performed by EPA contractors (SRC and NewFields). The primary database administrator will be Lynn Woodbury. She will be responsible for sample tracking, uploading new data, performing error checks to identify inconsistent or missing data, and ensuring that all questionable data are checked and corrected as needed. When the OU3 database has been populated, checked and validated, relevant asbestos data will be transferred into the Libby2 database for final storage.

2.0 BACKGROUND AND PROBLEM DEFINITION

2.1 Site Description

Libby is a community in northwestern Montana that is located near a large open-pit vermiculite mine. Vermiculite from the mine at Libby is known to be contaminated with amphibole asbestos that includes several different mineralogical classifications, including richterite, winchite, actinolite and tremolite. For the purposes of EPA investigations at the Libby Superfund Site, this mixture is referred to as Libby Amphibole (LA).

Historic mining, milling, and processing of vermiculite at the site are known to have caused releases of vermiculite and LA to the environment. Inhalation of LA associated with the vermiculite is known to have caused a range of adverse health effects in exposed humans, including workers at the mine and processing facilities (Amandus and Wheeler 1987, McDonald et al. 1986, McDonald et al. 2004, Sullivan 2007, Rohs et al. 2007), as well as residents of Libby (Peipens et al. 2003). Based on these adverse effects, EPA listed the Libby Asbestos Site on the National Priorities List in October 2002.

Starting in 2000, EPA began taking a range of cleanup actions at the site to eliminate sources of LA exposure to area residents and workers using CERCLA (or Superfund) authority. Given the size and complexity of the Libby Asbestos Site, EPA designated a number of Operable Units (OUs). In the early stages, efforts were focused mainly on wastes remaining at former vermiculite processing areas including OU1 (the export plant) and OU2 (the screening plant). As work progressed, attention shifted to cleanup of current homes and workplaces in the main residential/commercial areas of Libby, designated by EPA as OU4. To date, Superfund investigation and cleanup activities have been conducted by EPA within OU4 and some of the historic processing areas in and around the town of Libby. Environmental investigations of the nearby town of Troy, designated as OU7, began in the summer of 2007. The Phase I RI for OU3 was implemented in September – October of 2007.

Figure 2-1 shows the location of the mine and a preliminary study area boundary for OU3. EPA established the preliminary study area boundary for the purpose of planning and developing the scope of the RI/FS for OU3. This study area boundary may be revised as data are obtained during the RI for OU3 on the nature and extent of environmental contamination associated with releases that may have occurred from the mine site.

2.2 Basis for Concern at OU3

EPA is concerned with environmental contamination in OU3 because the area is used by humans for logging and a variety of recreational activities, and also because the area is habitat for a wide range of ecological receptors (both aquatic and terrestrial). Contaminants of potential concern to

EPA in OU3 include not only LA, but any other mining-related contaminants that may have been released to the environment.

2.3 Scope and Strategy of the RI at OU3

As noted above, EPA is conducting an RI in OU3 in order to characterize the nature and extent of environmental contamination and to evaluate risks to humans and ecological receptors from mining-related contaminants in the environment.

Respondents W.R. Grace & Co.-Conn. and KDC performed the first round of RI sampling (referred to as Phase I) in OU3 in the fall of 2007 in accord with the *Phase I Sampling and Analysis Plan for Operable Unit 3* (USEPA 2007). The primary goal of the Phase I investigation was to obtain preliminary data on the levels and spatial distribution of asbestos and also other non-asbestos contaminants that might have been released to the environment in the past as a consequence of the mining and milling activities at the site. A more extensive sampling and analysis effort, referred to as Phase II, will be performed in the spring, summer, and fall of 2008.

One component of the RI at OU3 includes characterizing exposure and risk to aquatic receptors that reside in surface water bodies that may be impacted by releases from the mined area. This includes the waters of Fleetwood Creek, Carney Creek, Rainy Creek, the on-site tailings and Mill Ponds, and potentially (if data indicate), the Kootenai River. Typically, water flow in these surface water features varies seasonally, being highest during the spring snowmelt period. Data are not available for typical flow patterns in Rainy Creek, but are available for several other streams in the area (Figure 2-2). As seen, in these creeks, flow usually begins to increase around day 80 (March 20) and peaks around day 140 (May 20), although this can vary widely from year to year. It is expected that flow patterns in Rainy Creek will be generally similar, but may be offset due to differences in elevation, gradient, and slope aspect.

Variation in water flow rate is potentially important because flow might have significant effects on the concentrations and amounts of asbestos and/or non-asbestos contaminants being carried by the water. For example, increases in both dissolved and total metal concentrations in surface water have been observed during spring runoff at other sites investigated by EPA in Region 8 (e.g., ISSI 2001, USEPA 2005). It is not known if asbestos or any other constituent will show similar patterns in the Rainy Creek watershed, but if such seasonal variations do occur, it is important to characterize the timing and magnitude of the variations. For this reason, the Phase II SAP for surface water and sediment is being prepared ahead of the other components of the Phase II SAP, in order to ensure that sample collection can include the spring runoff period. This portion of the Phase II SAP is referred to as Phase IIA. The remaining parts of the Phase II SAP will be provided in subsequent documents, referred to as Phase IIB and Phase IIC.

3.0 SUMMARY OF PHASE I SURFACE WATER AND SEDIMENT DATA

3.1 Sampling Stations

During Phase I, surface water and sediment samples were collected at a total of 24 locations, as shown in Figure 3-1. As seen, sampling stations include a number of locations along Carney Creek, Fleetwood Creek, and Rainy Creek, including ponds and impoundments on these streams, as well as seeps and springs that were located nearby.

3.2 Chemical Analyses

Surface Water

All surface water samples collected during Phase I were analyzed for asbestos, metals and metalloids, petroleum hydrocarbons, anions, and other water quality parameters. In addition, several selected surface water samples were analyzed for a broad suite of other chemicals, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), nitrogen-containing compounds, and selected radionuclides. These locations were selected specifically to characterize waters generated by the confluence of flows from the upper and lower portions of the mined area. Table 3-1 lists the analytical methods that were employed, and Table 3-2 shows the analyses that were performed at each station.

Sediment

All sediment samples collected during Phase I were analyzed for asbestos, metals and metalloids, petroleum hydrocarbons, and several sediment quality parameters. In addition, several selected sediment samples were analyzed for a broad suite of other chemicals, including cyanide, pesticides, PCBs, VOCs, SVOCs, and PAHs. Table 3-3 lists the analytical methods that were employed, and Table 3-4 shows the analyses that were performed at each station.

3.3 Phase I Field Results

Detailed surface water and sediment data from the Phase I investigation for both asbestos and non-asbestos analytes are provided in Attachment A. Attachment A.1 presents electronic data deliverables (EDDs) for all surface water and sediment samples collected as part of the Phase I investigation. Attachment A.2 presents a summary and interpretation of the quality control samples collected as part of the Phase I investigation that are specific to the surface water and sediment results discussed below.

The following sections summarize the surface water and sediment field sample results from the Phase I investigation. Data reported here include summary statistics on the detection frequency and observed levels of each analyte evaluated in each medium (surface water and sediment).

In considering these data, it is important to note that detection of a chemical in a site medium may not indicate that a release has occurred, since many of the detected chemicals occur naturally in the environment. In addition, concentration values may tend to vary over geographic area and time (e.g., concentrations may potentially be higher during spring runoff than during the fall). Therefore, it is important to collect data that provide adequate spatial and temporal representativeness before comparing to benchmarks or using the data to assess potential risk to humans or environmental receptors.

Asbestos in Surface Water

Table 3-5 summarizes the results of the analysis of surface water and seeps for asbestos (LA). Results are expressed in terms of million fibers per liter (MFL). As seen, concentration values of total LA ranged widely (more than four orders of magnitude), from < 0.1 to 125 MFL.

Figure 3-2 is a map that displays the spatial pattern of results. The highest levels were observed in samples located in ponds or impoundments, including the tailings impoundment, the Mill Pond, and the pond on Fleetwood Creek, as well as from several seeps along the south side of the mined area. Levels in lower Rainy Creek (below the Mill Pond) tended to be relatively low. A sample collected just upstream of the confluence of Rainy Creek and the Kootenai River was non-detect.

Asbestos in Sediment

Sediment samples were divided into two fractions (coarse and fine) by sieving. Concentrations of LA in the coarse fraction were measured gravimetrically and expressed as a mass percent (grams of LA per 100 grams of coarse fraction). Concentrations in the fine fraction were measured using polarized light microscopy using a visual area estimation approach (PLM-VE). Results for PLM-VE are expressed as mass percent if the concentration is 1% or higher. If the estimated concentration is <1%, the results are expressed semi-quantitatively, according to the following scheme:

PLM-VE Result	Range of Mass Percent
Bin A (ND)	None detected (likely < 0.05%)
Bin B1 (Trace)	LA detected, > 0% but < 0.2%
Bin B2 (<1%)	LA detected, >0.2% but < 1%

Results that are >1% are categorized as Bin C. Table 3-6 summarizes the results of the analysis of asbestos (LA) in sediment. As seen, nearly all (22 out of 24) of the sediment samples

collected contain LA. In the fine fraction, values ranged from trace (<0.2%) up to 7%. In the coarse fraction, levels generally ranged from 0.1% to 0.5%.

Figure 3-3 shows the spatial pattern of LA in the fine fraction of sediment. As shown, LA was be detected in most samples, except those collected in the upper-most reaches of Rainy Creek and Fleetwood Creek. Concentrations of 1% or higher (Bin C) were detected in multiple locations. The highest levels observed were in samples collected from on-site seeps.

Results for Non-Asbestos Chemicals in Surface Water

Table 3-7 presents summary statistics on the frequency and level of analytes detected in surface water samples analyzed as part of the Phase I investigation. As seen, a number of inorganic constituents (metals, anions, and nitrogen compounds) were detected, as were several indicators of petroleum hydrocarbons; but no VOCs, SVOCs, PCBs, or PAHs were detected.

Results for Non-Asbestos Chemicals in Sediment

Table 3-8 summarizes the results for analytes detected in sediment samples analyzed as part of the Phase I investigation. As seen, a number of inorganic constituents were detected, as were several indicators of petroleum hydrocarbons. The laboratory noted that the composition of some of the petroleum hydrocarbons detected did not resemble the composition expected for man-made fuels, and might be natural in origin. In addition, methyl acetate was detected in two samples, and pyrene was detected in one sample. All other chemical analytes were never detected in any sample. As noted above, it is not appropriate to draw any strong conclusions regarding whether or a release has occurred or whether any of the values are of potential concern until additional data are collected to ensure adequate representativeness of the data.

Results of Flow Measurements

Flow measurements were performed at a number of stations in the Rainy Creek watershed. Results are presented in Table 3-9. As seen, flows were generally low, especially in Fleetwood Creek, Carney Creek, and the upper reaches of Rainy Creek (URC-1 and URC-2). Flows from the tailings impoundment and in lower Rainy Creek were in the range of 0.3 to 0.8 ft^3/sec.

4.0 DATA QUALITY OBJECTIVES

4.1 Overview of the DQO Process

Data Quality Objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected (EPA, 2006). The design of a study is closely tied to its DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and the analyses to be performed. In brief, the DQO process typically follows a seven-step procedure, as follows:

1. State the problem that the study is designed to address
2. Identify the decisions to be made with the data obtained
3. Identify the types of data inputs needed to make the decision
4. Define the bounds (in space and time) of the study
5. Define the decision rule which will be used to make decisions
6. Define the acceptable limits on decision errors
7. Optimize the design using information identified in Steps 1-6

Following these seven steps helps ensure that the project plan is carefully thought out and that the data collected will provide sufficient information to support the key decisions which must be made.

4.2 Conceptual Site Models

Figure 4-1 presents the conceptual site model for how humans may be exposed to contaminants in surface water and sediment within OU3. The maximally exposed human receptor is assumed to be an area resident who hikes or fishes along surface water features such as Rainy Creek or some of the ponds. Exposure is primarily *via* incidental ingestion of surface water or sediment. This would apply primarily to non-asbestos contaminants, but oral exposure to LA via incidental ingestion of water or sediment might also be of potential concern[1]. In some cases, airborne exposure may also occur by disturbance of dried sediments along stream banks. This would be of concern mainly for asbestos contamination, with only low concern for non-asbestos contaminants.

Figure 4-2 presents the conceptual site model for how ecological receptors may be exposed to contaminants in surface water and sediment at the site. The maximally exposed ecological receptors are fish or benthic invertebrates that live in the streams or ponds. Wildlife (birds, mammals) may also be exposed while feeding or drinking along the streams or ponds.

[1] Note: In most cases, inhalation exposure to asbestos is the main reason for human health concern, with only minor concern for ingestion exposures. This is true, for example, in Libby OU4. In OU3, because of the assumed intake of LA in water and sediment by some recreational visitors, it is possible that oral exposure might begin to contribute risks that are not minor compared to the inhalation pathway, so ingestion exposure to LA will be evaluated in this case.

4.3. Data Quality Objectives for Phase IIA Surface Water and Sediment Sampling

4.3.1 State the Problem

Data from Phase I on the levels of LA and other analytes in surface water and sediment represent an observation at one point in time. Because concentrations of contaminants in surface water may vary over time, especially in cases where there are large fluctuations in flow (e.g., during spring runoff), additional data are needed to characterize the levels of site-related contaminants in surface water as a function of time (season) as well as space. Similarly, the degree of variation in sediment concentrations over time is not known, and additional data are needed to assess how the levels of asbestos and other contaminants in sediments vary over season in OU3 drainages.

4.3.2 Identify the Decision

Ultimately, the data collected during the OU3 RI is intended to help EPA decide if and what response actions, if any, are needed to protect human and/or ecological receptors from unacceptable risks from asbestos and any other mining-related contaminants in surface water and sediment in OU3.

4.3.3 Identify the Types of Data Needed

Contaminant Concentration Data

One type of data that is needed to evaluate risks from contaminants in surface water and sediment is reliable and representative measurements of the concentration of contaminants in surface water and sediment as a function of both time and space. This type of data is valuable both to support risk evaluations (when reliable toxicity values are available) as well as to identify sources of contaminant releases.

In Phase I, the target analyte lists for surface water and sediment included not only asbestos but also a wide variety of other chemical classes (see Tables 3-1 and 3-3) in order to seek information on the occurrence of a number of chemicals that might have been used at the site or that might have been released to the environment due to mining activities. However, because Phase I reflects concentrations at only one point in time, these data may not be representative of variations in concentration levels over time (season), and hence the Phase I data alone are not considered sufficient to allow reliable evaluation of either the nature and extent of contamination or of the level of risk to humans or ecological receptors. Therefore, all of the analytes assessed in surface water and sediment during Phase I are retained for further evaluation in Phase IIA.

Site-Specific Toxicity Tests

For ecological receptors, direct measurements of observed effects from exposing receptors (fish, benthic macroinvertebrates) to site media (surface water, sediment) are used to assess risks, especially for contaminants for which reliable toxicity values are not available to use in the hazard quotient (HQ) approach for evaluating measured concentration values. In site-specific toxicity tests, ecological receptors are exposed to site media of known concentrations in order to observe whether the media causes adverse effects on growth, survival, and/or reproduction in laboratory test species. Data from toxicity tests are used to establish a reliable site-specific exposure response curve. Using this relationship, it may be possible to identify reference concentrations of contaminants in water or sediment that represent the boundary between acceptable and unacceptable effects on aquatic receptors. If so, then these reference concentrations may be used in the evaluation of other site waters and sediments that have not been tested using aquatic receptors.

For the purposes of the Phase IIA sampling plan, the medium that is most time-critical for evaluation by site-specific toxicity testing is surface water. This is because it is expected that the concentration of LA (and possibly other site-related contaminants) may change during spring runoff. Site-specific sediment toxicity testing will also be a key component of the OU3 RI and ecological risk assessment. However, because it is not thought that sediment samples are likely to be as time-variable as water samples, collection of sediment samples for toxicity testing is not time critical and can be deferred for planning and implementation to Phase IIC.

Flow and Loading Data

If it is determined that releases of LA, or any other contaminant, from the site pose an unacceptable risk to humans and/or environmental receptors, then EPA needs to identify the sources of those unacceptable releases in order to evaluate remedial alternatives. One of the most useful types of information for evaluating the relative significance of water-borne releases is loading (the amount of contaminant carried in water per unit time). Loading is calculated as the product of concentration and flow. Thus, data on surface water flow rates are needed to characterize the temporal variations in stream flow rates at numerous locations in the Rainy Creek watershed so that the load carried by each reach may be assessed.

4.3.4. Define the Bounds of the Study

Spatial Bounds

The primary focus of Part A of the Phase II investigation is the Rainy Creek watershed, including upper and lower Rainy Creek, Fleetwood Creek, and Carney Creek, as well as ponds and impoundments on these streams. In addition, Phase IIA will include an evaluation of surface water in the Kootenai River in the vicinity of the confluence with Rainy Creek.

Temporal Bounds

Because surface water flow conditions are variable over time, the Phase IIA surface water investigations will be conducted during a typical range of annual flow conditions. The Phase IIA investigations will begin at close as feasible to the start of the rising hydrograph, and will continue through the high flow period and extend into the summer and fall. The purpose of this temporal sampling pattern is to characterize, at least within the year 2008, the pattern of temporal variability in concentration levels of contaminants of potential concern.

4.3.5. Define the Decision Rule

For human receptors, consistent with EPA guidance (EPA 1991), if the cumulative carcinogenic risk to an individual within OU3 based on the reasonable maximum exposure for both current and future land use does not exceed 1E-04 and the non-carcinogenic HQ does not exceed 1, remedial action generally is not warranted within OU3 unless there are adverse environmental impacts. EPA may also compare measured concentrations in OU3 to chemical-specific applicable or relevant and appropriate requirements (ARARs) to determine whether remedial action is warranted.

For ecological receptors, risk characterization will, to the extent that data allow, be based on a weight-of-evidence approach that utilizes one or more of the following strategies:

- Calculation of HQ values based on measured concentration values and available toxicity reference values (TRVs)
- Exposure of test organisms to samples of surface water and/or sediment collected from the site to evaluate the magnitude and frequency of any effects on growth or survival
- Direct surveys of receptor density and diversity in site streams in comparison to appropriate reference streams in the same area

The ecological decision rule will likely take the form that, if the weight-of-evidence indicates that adverse effects on fish and/or benthic organisms are occurring, and that these effects are likely to result in a meaningful decrease in the density and/or diversity of receptors compared to what would be expected in the absence of site-related contamination, then a response action will be appropriate.

4.3.6. Define the Acceptable Limits on Decision Errors

Two types of decision errors are possible when making risk management decisions:

- A false negative decision error occurs when it is decided that risk is acceptable when the true risk is actually above the level of concern

- A false positive decision error occurs when it is decided that risk is not acceptable when the true risk is actually below the level of concern

Of these two types of errors, EPA is primarily concerned with avoiding false negative errors, since an error of this type can leave human or ecological receptors exposed to unacceptable levels of contamination and risk. The EPA usually identifies 5% as the maximum acceptable probability of making a false negative decision.

A false positive decision error does not leave humans or ecological receptors at risk, but is also of concern to EPA because this type of error may result in the expenditure of resources (time, money) that might be better invested elsewhere. For the OU3 RI and risk assessment process, the goal is as follows: if the true level of risk is less than ½ the acceptable risk level, then there should be no more than a 20% chance that the risk will be declared to be unacceptable.

4.3.7. Optimize the Design

4.3.7.1 Optimizing the Design for Evaluation of Risks to Humans

The evaluation of risks to humans from exposure to asbestos and other site-related contaminants of potential concern will be based on a computational approach in which HQ values and lifetime excess cancer risks are calculated from available data. The probability of making either a false negative or a false positive decision error depends on the accuracy of all of the information used to make the calculations, including the concentration term, the exposure parameters, and the toxicity term. In general, EPA seeks to limit the risk of false negative decision errors by ensuring that all uncertain inputs into risk calculations are "conservative" (i.e., are more likely to overestimate than underestimate risk). Of the uncertain inputs, the only one that is amenable to control during field sampling and analysis is the uncertainty in the concentration term. For this reason, attention in the sampling plan is focused on optimizing the number of samples that will be available for estimating average exposure levels in each exposure area for each environmental medium.

The number of samples needed to limit uncertainty in concentration term depends mainly on the nature of the underlying distribution and the degree of between-sample variability. The degree of uncertainty that can be accepted depends mainly on how close the data are to a decision criterion. That is, greater uncertainty is acceptable when the values are far removed (either below or above) the decision criterion than when the values are near the decision criterion.

Non-Asbestos Analytes

For non-asbestos analytes, environmental data sets are generally observed to be right-skewed and are often reasonably well approximated by lognormal distributions. Based on this, Monte Carlo simulation can be used to characterize the relationship between the number of samples collected

and the probability of a false positive decision error based on the upper confidence limit (UCL) of the mean of an observed lognormal data set. Figure 4-3 shows the results of several example situations. In Panel A, the geometric standard deviation (GSD) of the lognormal distribution is assumed to be 2.0 (a typical value for environmental data sets). The blue curve shows the false positive error rate when the true mean of the lognormal distribution is assumed to be ½ the risk-based concentration (RBC). As seen, for this GSD, about 14 samples are needed to achieve the DQO (<20% false positives when the true mean is ½ the RBC). When the true mean is further below the RBC (ratio = 0.2), then only about 6 samples are needed to limit the false positive decision error to 20% (red line). Panel B shows the same relationships, except the GSD is assumed to be 3.0 (a value that may occur in some data sets). In this case, the number of samples needed to achieve the DQO when the true mean is ½ the RBC is about 38 (blue line), and is about 12 when the true mean is 1/5 the RBC (red line).

LA in Water

For asbestos, uncertainty in the mean concentration of a data set arises not only from the authentic between-sample variability, but also from uncertainty that is inherent in the methods used to measure the asbestos concentration. For water samples, concentration values for each sample are derived based on the number of fibers observed during a microscopic inspection of an aliquot of the sample. The number of fibers observed is a random variable characterized by a Poisson distribution. Because of this Poisson variation in each measured value, the overall uncertainty is a combination of the sampling variability and the measurement error, which results in a Poisson-lognormal (PLN) distribution. At present, the EPA has not established a method for quantifying the uncertainty in the mean of such a data set. However, it is known that the magnitude of the uncertainty depends on the number of samples, the variability of the underlying lognormal distribution, and the average number of LA particles counted in the analysis of each sample. In general, if the number of particles counted is large (e.g., 50 or more), then the contribution of Poisson uncertainty tends to be small and the source of variation is mainly due to the lognormal sampling variability. If the number of LA particles counted is small (e.g., less than 10), then the contribution of the counting error becomes more important and uncertainty bounds widen substantially.

For this reason, analytical counting rules are set such that, if fibers are present at concentration that is near the level of concern, then the number of fibers observed during an analysis will be high (about 50 or more). Figure 4-4 shows the results of several Monte Carlo simulations based on this condition (average count = 50). Results are presented as the ratio of the observed sample mean divided by the true mean. As expected, the width of the uncertainty distribution (the distance between the 5^{th} and the 95^{th} percentile) tends to narrow as sample number increases, and tends to increase as the GSD increases.

In the absence of an approved method for computing the UCL of a PLN data set, it is not yet possible to perform a quantitative analysis of decision error rates as a function of sample size.

However, it is apparent from inspection of Panel A that at least 20 samples are needed to ensure that the uncertainty range does not exceed about ± 50-60% for a distribution whose assumed GSD is 2-3. Increasing the sample number to 40 would be expected to narrow the uncertainty interval to about ±30-40%. Thus, when concentrations are near a level of concern, the target is to collect 20-40 samples. If the concentration is not near a decision criterion, then a data set of 10-20 samples is likely to be acceptable.

LA in Sediment

For sediment, the best method currently available for asbestos yields mainly semi-quantitative results, and the uncertainty around each measurement can not be quantified. Thus, there is no statistically valid approach for deriving a quantitative estimate of the mean for a set of samples, or to quantify the uncertainty about the mean. In the absence of a valid statistical approach, based on general statistical principles, EPA has determined that a data set of about 10-20 samples per exposure unit is likely sufficient in order to have a semi-quantitative understanding of spatial and potentially temporal variability of sediment levels in the exposure unit.

Summary

In summary, reliable characterization of the nature and extent of mining-related contamination and the level of risk to humans associated with contaminants in surface water and sediment require that samples are representative in space and time, and that a sufficient number of samples are collected so that estimates of average concentration values may be calculated with acceptable confidence.

As described above, the sampling plan for surface water has been designed to ensure good spatial and temporal representativeness of the drainages in OU3. The exact number of samples needed to limit uncertainty in the mean in any specific location is a complex function of the between-sample variability and how close the values are to a decision criterion. For OU3, the following guidelines have been selected to guide the sampling strategy:

Analyte Class	Number of Samples per Exposure Unit	
	Values are not near a decision threshold	Values are near a decision threshold
Non-asbestos	6-12	14-38
Asbestos	10-20	20-40

Although work on the human health risk assessment has not begun, it is expected that the following exposure units will be used:

- Upper Rainy Creek
- Lower Rainy Creek

- Tailings Impoundment
- Mill Pond
- Fleetwood Creek
- Carney Creek

If so, the number of samples for each exposure unit at the completion of Phase IIA (including the data from Phase I) would be as shown in Tables 4-1 (surface water) and Table 4-2 (sediment). As seen, all onsite stations will have at least 3 samples, and most proposed Exposure Units will have a sufficient number of samples (15 to 40) to achieve the DQOs for evaluation of human health risk.

4.3.7.2 Optimizing the Design for Evaluation of Risks to Aquatic Receptors

As noted above, risks to ecological receptors, including fish and benthic invertebrates, will be based on a weight-of-evidence evaluation. Consequently, it is not possible to develop statistical rules that limit the likelihood of false positive or false negative decision errors. Rather, the degree of confidence in the decision is based on the quality of the data available, and the degree to which different lines of evidence yield consistent conclusions. If multiple lines of evidence support the same conclusion, then confidence in the decision is increased. Conversely, if different lines of evidence yield inconsistent conclusions, then confidence in the decision is decreased.

HQ Approach

In the case of aquatic receptors, it is common to begin by an assessment of risks from surface water using the HQ approach. Note, however, that this requires the availability of suitable TRVs for the contaminants of concern in surface water. Such TRVs are available for most non-asbestos analytes, and the HQ approach will be used as the first line of evidence for this group of contaminants. If the HQ results suggest that risks are below a level of concern, then no further evaluation will be needed. If the HQ approach suggests that risks may be occurring, then other lines of evidence will be investigated.

In the case of asbestos, no TRV values are currently available. Even if such values were available, their relevance to OU3 would be uncertain because the toxicity of asbestos may depend on the mineral type (LA) and on the particle size distribution in site waters. For this reason, the first line of evidence evaluated will be site specific toxicity testing. This will provide direct data on the toxicity of site waters to an appropriate fish species (rainbow trout). Assuming that the site water produces toxicity, then a site-specific TRV can be developed by testing a series of dilutions of the site water, and the resultant site-specific TRV may then be used to predict, using the HQ approach, the expected toxicity of LA in other site waters that have not been tested using fish.

Sampling Design for Site-Specific Toxicity Testing

The objective of site-specific toxicity testing is to develop a site-specific exposure-response curve for toxicity in fish. This is best achieved by testing waters at regularly-spaced concentration intervals ranging from low to high. Serial dilution of one surface water sample collected from one sampling location within OU3 was selected as the sampling design to meet the Phase IIA objective.

Since one site water will be used in Phase IIA, it is important to select this water such that the level of LA is at or near the high end of the range of concentrations that occur in on-site waters. This is because the data would have low utility if the water sample tested had relatively low levels of LA, and no toxicity was observed. In order to ensure that water sample selected for testing is at the high end of the range observed on-site, samples of site waters from six stations will be evaluated weekly for LA during the rising and peak phase of the hydrograph. Analytical results will be reported as quickly as possible by the analytical laboratory, so that when a sample is observed that is judged to be at or near the maximum, it will be possible to quickly direct the collection of a large sample of that water for testing.

Inspection of the surface water results for LA from Phase I, it appears that the highest concentrations of LA tended to occur in the ponds and impoundments, and also in the influent waters to those ponds. On this basis, the 4 stations selected for rapid turn-around monitoring during the spring are as follows:

Fleetwood Creek Pond (FC-Pond)
Tailing impoundment (TP)
Mill Pond (MP)
Upper Rainy Creek above mine area (URC-2)

Other lines of evidence (site-specific population surveys, examination of the frequency and severity of histological lesions in fish) will be included in Phase IIC of the OU3 SAP.

4.3.7.3 Optimizing the Design for Evaluation of Flow and Loading

The basic strategy for identifying sources and relative amounts of LA release into site waters is to collect flow and LA concentration data at multiple locations at the site. By comparing loading (concentration x flow) at different stations, the amount of LA that is added (or lost) in each segment of the Rainy Creek drainage can be computed. As noted above, because flow is variable over time, especially during spring runoff, the sampling strategy is to collect measures of flow and concentration at each station at a series of times during the rising and falling phases of the hydrograph, during storm events, and during more nearly baseflow conditions in the summer and fall.

5.0 SAMPLING PROGRAM

All sampling of environmental media within OU3 described in this SAP will be performed by personnel who are properly trained in the field collection methods summarized in the OU3 Standard Operating Procedures (SOPs) provided in Attachment B and the Phase IIA experimental sampling design details presented below. The field sampling teams will follow procedures in the Health and Safety Plan (HASP) prepared by MWH for the OU3 investigation.

Table 5-1 provides an overview of a number of data collection activities that will be performed under Phase IIA of the OU3 RI. The following sections present the experimental design, including sampling details and rationale, for the Phase IIA elements of surface water and sediment characterization.

5.1 Rainy Creek Watershed Monitoring – Experimental Design

A Phase I investigation within the Rainy Creek watershed was completed in the fall of 2007 to provide an initial characterization of conditions at and surrounding the Libby Mine site. Further characterization of surface water and sediment was anticipated as part of Phase II. This section describes the experimental design for Phase IIA data collection activities developed to meet data needs for surface water and sediments within the Rainy Creek watershed, as discussed above in Section 4.3.

5.1.1 Element 1: Seasonal Surface Water and Sediment Monitoring

As noted previously, it is expected that flow and contaminant concentration will vary in each portion of the Rainy Creek watershed as a function of time of year. The purpose of Element 1 is to measure stream flow and contaminant concentrations (LA as well as other non-asbestos contaminants) in surface water and sediment at each location previously sampled in Phase I to characterize levels during spring and summer flow conditions. These data may be combined with similar Phase I data collected during the fall of 2007 to develop an understanding of the seasonal variability in flow and concentration patterns across the site. These data, in turn, will form one part of the data set used to evaluate exposure and risk to human and ecological receptors, as well as an understanding of sources and loading during spring and summer flow regimes.

Surface Water Samples

Figure 5-1 identifies the locations where samples of surface water will be collected during Phase IIA. These are the same locations where samples were collected during Phase I, plus the following additional locations:

- Upper Tailings Pond (UTP). The tailings impoundment consists of two parts: the main tailings impoundment, which is relatively shallow, and an upper pond that is somewhat deeper. In Phase I, surface water was collected only from the shallow portion of the impoundment. However, the deeper portion of the impoundment is relevant habitat for ecological receptors, and also requires sampling. Because of its depth, samples will be collected both from the surface and from near the bottom.
- Tailings Pond Overflow (TP-Overflow). This location in the overflow channel for the tailings impoundment has been added to characterize the concentration and load of LA and other contaminants that may be released during periods of high flow that over-top the impoundment.
- Rainy Creek upstream of the mining-disturbed area and about 100 yards north of Rainy Creek Road (URC-1A). This station has been added to help define the contribution of releases from the road to contaminant levels at URC-2.
- Pond on Carney Creek (CC-Pond). This station has been added because the existence of the pond was not recognized during the Phase I sampling program and no data from this location have been collected.

If any significant new seeps, springs, or other water features are observed by the field sampling crews during Phase IIA that were not recognized during Phase I, the EPA RPM will be notified and these will also be selected as new sampling stations.

Table 5-2 identifies and describes all of the Phase IIA surface water monitoring locations.

Surface water samples will be collected from each station once in late spring following peak runoff and once in the summer. All surface water samples collected under Phase IIA Element 1 will be analyzed using the same approach as used previously in Phase I. In brief, all samples will be analyzed for asbestos, metals/metalloids, petroleum hydrocarbons, anions, and other water quality parameters. In addition, a broad suite of analyses will be performed for samples collected at the tailings impoundment toe drain (TP-TOE1) and Lower Rainy Creek downstream of the confluence with Carney Creek (LRC-2). These locations were selected because they appear to have the best potential of characterizing releases from the mine. The additional analyses for surface water include PCBs, pesticides, herbicides, gross alpha/gross beta, VOCs, SVOCs, and cyanide. These analyses will provide a more comprehensive screen for potential contaminants associated with mine wastes and process chemicals used during mine operations. Details on the specific chemical analyses that will be performed for surface water samples under Element 1 are discussed in Section 6 (see Table 6-1).

Water quality data for springs will provide information on shallow groundwater quality. Seep water will provide information on whether contaminants are being released from mine waste piles and disposal areas. These data, along with any groundwater sampling data collected as part of Phase IIB, will allow for identification of mine-related contaminants and possibly an assessment of transport pathways.

At locations where flowing water is present, stream flow rate will be measured following the collection of surface water and sediment samples. Flows will be measured at locations on Fleetwood Creek, Rainy Creek, Carney Creek, at the TP-TOE1 drain and TP-Overflow (if running). Flow data will be used with contaminant concentration data to assess contaminant mass transport along surface water transport pathways.

Sediment Samples

Sediment samples will be collected once in late spring following peak runoff and once in late summer, from the same locations and at the same time as surface water samples (see Figure 5-1). The sediment data collected during Phase IIA will be used in conjunction with data collected during Phase I to evaluate sediment heterogeneity at each location and to assess seasonal variability in sediment concentrations, if any.

The Phase IIA sediment sampling plan differs from Phase I in that the tailings impoundment and each of the ponds (the Mill Pond and the ponds on Carney Creek and Fleetwood Creek) will each be sampled by collecting a series of grab samples rather than 1-2 composite samples. The purpose of collecting multiple grab samples from the tailings impoundment, the Mill Pond, and the ponds on Carney Creek and Fleetwood Creek is to provide information on the spatial variability within each feature. This is important mainly for evaluating risks to benthic organisms in the ecological risk assessment.

Figure 5-2 shows the approximate location of 17 sampling locations in the tailings impoundment. These sample locations are focused mainly in areas that are always or usually inundated with water, since these areas are most likely to serve as habitat for aquatic receptors. However, five samples are placed in areas that may be occasionally inundated. The exact sampling locations may be revised based on field conditions at the time of sampling. Sediment sampling locations from the tailings impoundment will be identified with a "TP-" prefix and numbered sequentially (e.g., TP-1, TP-2, ..., TP-17).

At the three other ponds (the Mill Pond and the ponds on Carney and Fleetwood Creeks), a total of 5 sediment grab samples will be collected from each pond. These will consist of 3 samples from around the margins of the pond (at least 3 feet in from the edge), and 2 samples from near the center of the pond. Sediment sampling locations from the Mill Pond, Carney Creek Pond, and Fleetwood Creek Pond will be identified with an "MP-, "CC Pond-", or "FC Pond-" prefix, respectively. Edge samples will be identified as locations -1, -2, and -3, and center locations will be identified as locations -4 and -5 (e.g., CC Pond-1 = edge, CC Pond-4 = center).

More detailed procedures for collection of sediment samples associated with this element of Phase IIA are given below in Section 5.3.4.

All sediment samples will be analyzed for asbestos, metals/metalloids, and petroleum hydrocarbons, and total organic carbon. Sediments from lower Rainy Creek (LRC-1 to LRC-6) and the tailings impoundment toe drain (TP-TOE2) will be analyzed for PCBs to assess the potential effects of use of oil for dust control along the adjacent road. Sediment collected from TP-TOE2 and LRC-2 will also be analyzed for pesticides, herbicides, VOCs, SVOCs, and cyanide. Details on the specific analyses that will be performed for sediment are discussed in Section 6.

5.1.2 Element 2: Spring Runoff Monitoring

The purpose of Element 2 is to monitor stream flow and surface water asbestos concentration values at selected stations within the Rainy Creek watershed during the rising and falling limbs of the spring-season snowmelt-runoff hydrograph. These data will be used as part of the data set to evaluate exposure and risk to human and ecological receptors from LA, as well as to track changes in the asbestos loading and transport in surface water as stream flows first rise in response to snowmelt runoff and then decline as snowmelt ends.

Surface water samples will be collected once during winter base-flow conditions, and then weekly beginning at the onset of rising stream flows in response to snowmelt, continuing through the spring high-flow season, and ending approximately 4 weeks after the seasonal peak in flow is observed on Rainy Creek. Table 5-3 and Figure 5-3 identify the locations where samples of surface water will be collected under Element 2. Surface water samples will be collected weekly during the spring runoff season at the following locations:

- Tailings impoundment (TP*), impoundment toe drain (TP-TOE1), and impoundment overflow (TP-Overflow)
- Mill Pond (MP*)
- Rainy Creek upstream of the mine-disturbed areas (URC-1A, URC-2*)
- Fleetwood Creek (FC-2) and Carney Creek (CC-2) downstream of mine-disturbed areas
- Lower Rainy Creek below the Mill Pond (LRC-1) and below Carney Creek (LRC-2, LRC-6)
- Ponds on Carney Creek (CC-Pond) and Fleetwood Creek[2] (FC-Pond*)

Stations designated with "*" above are the locations where rapid turn-around of asbestos analysis is necessary to support selection of the appropriate location for surface water toxicity testing. All of the locations listed were sampled during the Phase I investigation except for one new station on upper Rainy Creek (URC-1A) and one new station at a pond along lower Carney Creek (CC-Pond). All but two of the locations selected for Element 2 are downstream of potential primary sources of asbestos, including mine waste piles and the coarse and fine tailings disposal areas,

[2] Weekly monitoring at FC-Pond will be suspended following selection of the water toxicity test location.

and downstream of potential secondary sources, including sediments in the Mill Pond and sediments deposited along lower Rainy Creek.

All surface water samples will be analyzed for asbestos. At locations where flowing water is present, stream discharge will be measured following the collection of surface water samples. Flows will be measured at locations on Fleetwood Creek, Rainy Creek, Carney Creek, at the TP-TOE1 drain and TP-Overflow (if running). Stream flows will be measured above and below the tailings impoundment (TP), Mill Pond (MP), and Carney Creek pond (CC-Pond) to evaluate flow-through and water residence times in these surface impoundments.

5.1.3 Element 3: Summer and Fall Monitoring

Routine Monitoring

Element 3 is an extension of Element 2 into the summer and early fall that is designed to provide ongoing information on asbestos concentrations and stream flow rates downstream of asbestos sources within the Rainy Creek watershed. Locations sampled in Element 3 are the stations on lower Rainy Creek below Carney Creek (LRC-2) (this location receives flow from both the upper and lower portions of the mined area) and lower Rainy Creek near its discharge to the Kootenai River (LRC-6). Element 3 will start immediately upon completion of Element 2 (i.e., approximately 4 weeks after the seasonal peak in flow), and continue through September 30. Instead of weekly sample collection and flow measurement at each location as for Element 2, monitoring will be reduced to every other week for Element 3. The surface water samples will be analyzed for asbestos. Wherever flowing water is present, stream discharge will be measured following sample collection.

The two locations selected for Element 3 both represent points on the potential surface water transport pathway from mine-related sources of asbestos to lower Rainy Creek and the Kootenai River. LRC-2 is downstream of all potential mining-related sources of asbestos and downstream of two ponds representing potential secondary sources to surface water (Mill Pond and pond on Carney Creek), and LRC-6 is downstream of all potential primary and secondary asbestos sources, including sediments deposited in the lower Rainy Creek drainage downstream of LRC-2.

Storm Event Monitoring

Element 3 will also include sampling and flow measurement triggered by precipitation events that occur after the spring snowmelt-runoff season. The same two locations, LRC-2 and LRC-6, will be used for monitoring during storm events. Asbestos concentration values and flow measurements will be obtained at LRC-2 and LRC-6 to describe asbestos transport associated with at least three separate storm/rainfall events within the Rainy Creek drainage and to evaluate the effect of short-term, episodic surface runoff in the mine area, and related increases in local

stream flow, on the asbestos content of surface water downstream of the known sources of asbestos.

The exact details of how storm-event monitoring will be implemented have not yet been established. The following sections provide a conceptual approach that may be modified based on a consideration of the recommendations of the field sampling team.

The most appropriate trigger for initiation of storm-even monitoring is not known, because no data exist regarding how much flow in Rainy Creek increases when storm events occur. A value of 100% (a doubling of average flow) will be used as an initial starting trigger. This value is at the low end of the possible increases in flow that are predicted by modeling. This value may be revised by EPA either upward or downward, as data are obtained on the actual changes in flow rate in the Rainy Creek drainage that result from storm events.

The amount of rain needed to cause a flow increase of this size in the Rainy Creek drainage is not known. Modeling conducted by Schafer (1992) indicates that a 10-year storm event of 2.4 inches over a 24-hour period causes increased flow in local drainage approximately 12 hours following the start of rainfall. The model used by Schafer to describe the storm hydrograph was developed for a basin of undisturbed, mature forest in good condition with moderately sloped topography. The model input parameters do not match conditions in the sparsely vegetated and bare areas of steeply sloping mine waste in the mining-disturbed portion of the basin. Therefore, storm hydrographs associated with runoff from the mine-disturbed areas may be larger and may occur sooner than predicted by the Schafer model.

A rain gage will be installed at the Libby Mine site meteorological monitoring station to provide the data needed to trigger storm-event monitoring. The rain gage will be equipped with a data logger to automatically track precipitation amounts and durations. When a rainfall event takes place, data collected at the meteorological station can be used to establish whether the event meets (or is likely to meet) the criteria given above for storm-event sampling. If so, surface water sample collection will be initiated after rising stream flow is observed in response to a qualifying storm event. Stream flow monitoring at LRC-2 may also be used to trigger storm-event-related monitoring.

The surface water sample collected at each location during each storm event will be a 24-hour, flow-weighted, composite sample. If the duration of rainfall is longer than 24 hours, additional 24-hour, flow-weighted composite samples will be collected to monitor water quality throughout the storm-related hydrograph (i.e., elevated stream flow associated with the rainfall event).

Collection of flow-weighted composite samples will require automated samplers with flow monitoring equipment. Automated samplers will be set up at LRC-2 and LRC-6 to collect the composite samples. Initially, a weir will be installed in the stream channel to allow for continuous flow monitoring. When conditions allow, the weirs will be replaced with installation of a flume. Each flow-weighted composite sample will be collected over a 24-hour period. The

same equipment will also be utilized for Element 4, as described below. Operation and maintenance of these automated sampling stations will be in accordance with procedures described in Section 5.3.3 and SOP Nos. 14 and 15.

5.1.4 Element 4: Continuous Precipitation and Flow Monitoring

Element 4 consists of continuous precipitation monitoring at the meteorological monitoring station at the Libby Mine site and continuous stream flow monitoring on lower Carney Creek and lower Rainy Creek. Flow monitoring will be conducted on lower Carney Creek during spring snowmelt runoff and on lower Rainy Creek during the spring snowmelt runoff, summer, and early fall. The purpose of collecting flow data on a continuous basis at these locations is to:

- characterize the spring snow-melt hydrograph while the other elements of the Phase IIA investigation are being implemented;
- track changes in flow in response to local precipitation events; and
- provide detailed flow measurements for use with asbestos concentration data to characterize asbestos mass loading to Rainy Creek from the mine site and from lower Rainy Creek to the Kootenai River.

Precipitation amounts and durations will be recorded using an 8-inch-diameter, heated, tipping-bucket rain gauge installed at the same location as the meteorological station that is currently in use at the Libby Mine site. The purpose of collecting continuous precipitation data is to determine the runoff coefficient as it relates to the precipitation intensity/duration curves for the Rainy Creek watershed. Installation and calibration of the precipitation station will be in accordance with the procedures described below in Section 5.3.5 and SOP No.17. This equipment will be installed in early spring to allow for developing relationships between precipitation and stream flow in Rainy Creek during the Phase IIA investigation.

Flumes/weirs (see Section 5.1.3) will be installed in the stream channels at three monitoring stations: LRC-2, LRC-6, and CC-2 (see Figure 5-3). Stream flow through the flumes will be monitored using water level sensors, and the continuous flow data will be recorded using a computerized data logger. Installation and calibration will be in accordance with the procedures described below in Section 5.3.6 and SOP No. 15. The automated flow monitoring equipment will be installed before the initial rise in stream flow associated with the spring snowmelt-runoff season and that equipment will be maintained for use through the summer and early fall.

5.1.5 Element 5: Collection of Water for Toxicity Testing

As discussed in Section 4.3.3, one of the most direct methods for evaluating toxicity of site media such as surface water and sediment to ecological receptors (fish, benthic invertebrates) is through site-specific toxicity testing. In this approach, test organisms are exposed to site media

in the laboratory to determine if the site media causes adverse effects on survival, growth and/or reproduction.

In Phase IIA, one site water will be selected for use in site-specific toxicity testing. As discussed previously, the water to be used will be selected by monitoring the levels of LA as a function of space and time, and seeking to collect a sample at a time and place that is at or near the high end of the range of concentrations observed on-site. This sample will then be evaluated in the toxicity testing protocol in an undiluted form, and in a set of serial dilutions that generate lower concentration values. The purpose of this study design is to generate a site-specific exposure-response curve that can then be used to evaluate site waters that have not been tested using fish.

If no toxicity is observed in the most concentrated (undiluted) water, this will be taken to indicate that, at least for the water tested, toxicity to fish is unlikely to be of concern. However, because of the potential for temporal variation between years in concentration levels of LA and other contaminants, follow-up studies may be needed to assess whether concern might exist in other years, and whether those higher values might be toxic.

The volume of water collected from the selected station will be approximately 200 L (about 50 gallons), which is sufficient to support the serial dilution toxicity testing protocol as described in Section 7. This water will be promptly chilled and transmitted to the toxicity testing laboratory.

5.2 Kootenai River Monitoring – Experimental Design

5.2.1 Surface Water

Phase IIA includes two rounds of sampling of water from the Kootenai River in the vicinity of Rainy Creek to assess the effect of Rainy Creek on asbestos levels in the river water. The first sampling event will occur at approximately the time of maximum flow in Rainy Creek, and the second event will occur under summer baseflow conditions in Rainy Creek.

Sampling stations for each event will include one location (designated UKR) upstream of Rainy Creek, three stations (designated KR-1, KR-2 and KR-3) parallel to the northern river bank downstream of the mouth of Rainy Creek, and 5 stations (designated KR-4 to KR-8) along a perpendicular transect downstream of Rainy Creek. The approximate locations of these stations are shown in Figure 5-4. These locations were selected to provide asbestos concentration values upstream and downstream of Rainy Creek and to include river locations with the greatest potential for elevated asbestos concentrations due to transport via Rainy Creek.

Each river-water sample will be collected from a discrete location using a depth-integrated sampler and in accordance with SOP No. 16 (Surface Water Sampling Using Depth-Integrated Samplers) and the instructions for surface water sampling in Section 5.3.1.

All samples of river water will be analyzed for asbestos.

5.2.2 Sediment

For the Kootenai River, sediment samples that will be collected include the following:

- One grab sample from a depositional area located along the north bank of the Kootenai upstream of Rainy Creek. This will serve as a frame of reference for evaluating downstream samples.
- Two or three grab samples from a depositional area located along the north bank of the Kootenai downstream of Rainy Creek, but within a distance of 1/2 mile.
- Two borings from the large sandbar located in the center of the river about 1/2 mile downstream. One boring will be from the highest location on the sandbar, since this may contain the oldest sediments. The other boring will be from a location near the downstream tip of the sandbar. Each boring will be to a depth that encounters the water level of the river, plus about 6 additional inches. Each boring will be subdivided into a total of four depths, or into 6-inch strata, whichever is smaller.

All samples of sediment collected from the Kootenai River will be analyzed for asbestos.

5.3 Field Procedures

5.3.1 Surface Water Sampling Methods and Procedures

The sampling procedures for collection of surface water grab samples are presented in OU3 SOP No. 3. During each monitoring event conducted for Rainy Creek watershed Elements 1 and 2, stream water samples will be collected from downstream to upstream locations to minimize the effect of sampling activities on the samples collected. To minimize the potential effect of time variability, all samples from a single stream drainage (i.e., Rainy Creek) will be collected on the same day. All samples will be grab samples, collected by pumping directly from the source into laboratory collection containers using a peristaltic pump. Samples will be collected from representative flowing water (usually the mid-channel).

Both filtered and unfiltered samples will be collected directly from the water bodies into sample bottles. At each station, the unfiltered sample will be collected before the filtered sample (or any other activities) to minimize the potential disruption of the sediment and resuspension of LA. For the filtered samples (to be analyzed for metals only), water from the source water body will be pumped through a 0.45 µm in-line, high-capacity filter using either a battery-operated peristaltic pump or hand-held manual pump. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled. A new (0.45 µm) in-line filter and tubing will be used for each site to collect water for analyses of "dissolved" constituent concentrations. The filter will then be removed, and the sample for unfiltered metals and other water quality parameters will be collected.

The method for collection of water at springs, seeps, and ponds will be the same as above, except in locations of very shallow water. In such locations, water can be collected from a depression created to increase the depth of water and allow for sampling using a pump and tubing, as described in OU3 SOP No. 3.

5.3.2 Surface Water Field Measurements and Flow Monitoring

Whenever grab samples of surface water are collected, the in-stream temperature, pH, specific conductance, dissolved oxygen (DO), and turbidity will also be measured using portable field meters. Field parameter measurement and calibration protocols will be performed according to manufacturer's specifications and OU3 SOP No. 10. These measurements will be recorded on field sampling forms.

At locations where flowing water is present, stream discharge will always be measured following the collection of surface water and sediment samples. The stream flow will be measured and recorded in accord with OU3 SOP No. 4. In brief, discharge will be measured using one of three portable methods, as dictated by flow or channel characteristics. Depending on the channel characteristics and flow, an area-velocity method, a portable flume, a volumetric method, or some combination of these methods, will be used to obtain the stream discharge measurements. Field personnel responsible for stream-discharge measurements must have prior experience using the methods and equipment described in OU3 SOP No. 4.

In cases where water depth is greater than 0.3 feet or the channel cross section is wide, flow generally will be measured using the area-velocity method of stream-flow gauging as described in the *National Handbook of Recommended Methods for Water Data Acquisition* (USGS 1977), and explained in detail in OU3 SOP No. 4. Using this method, the stream cross section is divided into a series of subsections where the average depth, average velocity, and width for the subsections are measured.

A portable cutthroat flume will be used to measure flow when low discharge and/or channel geometry preclude the use of a velocity meter. The flume will have a throat width adjustable from 2 to 8 inches, which can be used to measure flows from approximately 0.01 to 2.2 ft^3/sec. All water will be routed through the leveled flume, to the extent practicable, after which the height (to the nearest 0.01 foot), throat width, and leakage estimate as a percentage (if any) will be recorded. Discharge will be calculated using these data and an equation that is specific to the flume size.

In cases where flows are too small or stream gradients are too great to be measured using the area-velocity method or a cutthroat flume, measurements will be made volumetrically using a calibrated collection container and a stopwatch. Stream flow will be routed through a PVC pipe and the time to fill a collection container to a known volume will be measured. A minimum of

five trials will be executed for each volumetric measurement, and discharge will be taken as an average of the five trials. An estimate of any leakage around the routing pipe will be recorded.

5.3.3 Automated Sampler Specifications and Procedures

The automated sampler chosen for this application must be capable of creating flow-derived composite samples. Therefore, it is crucial that the pressure transducer in the flume and the automated sampler are compatible. The flow-derived composite sample can be created by varying the aliquot volume at a constant time interval or by varying the time interval and keeping the aliquot volume constant. Either method should be adequate to determine contaminant loading rates during storm runoff.

The automated sampler will be located out of the floodplain, on relatively level ground, but not above the suction head capacity of the automated sampler pump. Additionally, the intake line to the sampler will be kept as short as possible to minimize cross-contamination of the samples and the intake installed upstream or within the approach to the flume. It may be necessary to place the sampler in a securable enclosure if extreme weather and/or vandalism are reasonably anticipated. If connection to a power source is available, the automated sampling station will operate on 120VAC.

Routine maintenance of the automated sampler will be completed during each visit. The unit will be checked for faults, errors, or alarms during the previous sampling interval and the associated issues will be resolved. It will be determined if adequate sample volumes were collected and reprogramming of the sampling interval/volume will be completed if necessary. After each sampling event, the pump tubing will be inspected for wear and replaced if necessary. The intake line will be cleaned and the intake foot will be inspected to verify that is not buried in newly deposited sediment or plugged by debris.

Additional detailed instructions for the operation and maintenance of automated sampling stations is provided in SOP No. 14.

Respondents W.R Grace & Co.-Conn, and KDC shall submit to EPA and MDEQ the details of the automated sampler chosen for Phase IIA including specifications, conceptual drawings of the installation and operations and maintenance instructions.

5.3.4 Sediment Sampling Methods and Procedures

At each sampling location, sediment will be collected in accord with OU3 SOP No. 5. In brief, a single sediment sample will be collected from each station. Each sample will consist of a grab sample collected from low-energy (i.e., depositional) portions of the stream channel that are inundated by creek water at the time of sampling (i.e., locations of sediment deposition to channel). Each grab sample will be collected using the "direct sampling" method and

compositing instructions included in OU3 SOP No. 5. The mass of sediment collected may be estimated by visual assessment of sediment volume.

All sampling and field measurement equipment that is used at more than one sample station must be decontaminated following each use. Appropriate equipment decontamination procedures are provided in OU3 SOP No. 7.

5.3.5 Precipitation Monitoring

The precipitation monitoring station will be installed at the same location as the existing meteorological station at the site. This monitoring station will be equipped with a wind shield for better accuracy as well as 2 heaters maintained at 40°F (one on the collector funnel and one on the drain tube) to allow for measurement of precipitation under freezing conditions. The gauge will be compatible with the power supply and the data-logger/data-transmission system that are currently used at the meteorological station. The gauge will have a resolution of 0.01 inches with a range of 0-10 inches per hour. The accuracy will be at least ± 0.02 inches or 4% of the hourly total (whichever is greater). The gauge will log or transmit the date and time for each tip (0.01 inches) so that duration/intensity curves can be derived from the data collected.

The rain gauge will be installed in an area that is representative of the Rainy Creek watershed within a reasonable distance (i.e., <100 yds) from the existing meteorological station. The instrument will be calibrated after installation and the calibration will be checked at least once every three months thereafter. Installation, calibration, and maintenance procedures are provided in OU3 SOP No.17.

Respondents W.R Grace & Co.-Conn, and KDC shall submit to EPA and MDEQ the details of the precipitation monitoring station chosen for Phase IIA including specifications, conceptual drawings of the installation and operations and maintenance instructions.

5.3.6 Continuous Flow Monitoring with Data Logger

Each continuous flow monitoring station will be capable of measuring flows from 0.1 to 10 ft^3/sec (40-4,000 gallons/min). This flow range should be adequate to measure a typical spring snowmelt event as well as base-flow conditions, but it may not be large enough to measure large storm events such as the predicted 10 year, 24-hour storm which has a 150 ft^3/sec peak flow (Schaffer 1992).

The flow monitoring station design is dependent on the specific sampling location chosen in the drainage. At a minimum, the final design must be capable of measuring the flows described in the above paragraph (0.1 to 10 ft^3/sec) while achieving an accuracy of no worse that ±10% and a precision no worse than ±15%. The final design must also be capable of withstanding complete submergence without incurring permanent damage. If it is infeasible to install the final design

prior to the 2008 spring runoff, a temporary monitoring station may be used until a permanent station can be constructed. Temporary monitoring stations must be capable of measuring the same flow range but with an accuracy of no worse than ±25% and a precision no worse than ± 50%. The accuracy and precision should be checked at least quarterly.

The data logger must be setup to record water level measurements on intervals no longer than 15 minutes. If possible, a shorter interval is preferred because it will allow for post-processing of the data to reduce the inherent noise of the instrument and measurement technique. The data logger must be capable of storing at least one month's worth of measurements. A pressure transducer with internal memory, an internal battery, and capable of measuring up to 5 psi (11.5 ft of H_2O) is recommended for this application. It should also be capable of communicating with an autosampler to trigger flow-weighted composite sample collection.

Respondents W.R Grace & Co.-Conn, and KDC shall submit to EPA and MDEQ the details of the continuous flow monitoring stations including specifications, conceptual drawings of the installation and operations and maintenance instructions.

5.3.7 Field Documentation

Field documentation procedures are described in Section 5.5 and OU3 SOP No. 9. Field documentation associated with surface water and sediment sampling will also contain information of sufficient detail to fully describe:

- sample depth (sediment),
- sampling method, and
- associated field measurements, including stream discharge if measured, and field measurement methods.

Field measurement values are generally reported directly in the units of final use in the field notebook and data sheets without need for additional calculations (e.g., pH, temperature, and conductivity measurements). The field data will be reviewed daily by the field supervisor to identify anomalous data and transcriptional and/or computational errors. Corrective actions will be initiated as appropriate; these actions may consist of re-measuring a particular parameter, collecting a new sample, or other applicable corrective action measures.

5.4 Sample Handling Instructions

5.4.1 Sample Containers

All sample containers used for sample collection and analysis for this project will be prepared according to the procedures contained in the EPA document, *Specifications and Guidance for Obtaining Contaminant-Free Sample Containers,* dated December 1992. This document

specifies the acceptable types of containers, the specific cleaning procedures to be used before samples are collected, and requirements relevant to the containers and cleaning procedures. The analytical laboratories will supply all sample containers utilized for this investigation, both for asbestos and non-asbestos analyses. If field personnel observe any cracked or dirty containers, or if the appropriate preservative is missing in the sample bottles, those containers will be discarded and the laboratory will be notified of the problem to prevent its re-occurrence.

Tables 5-4 and 5-5 identify the appropriate sample containers for the analysis methods used in Phase IIA for surface water and sediment samples, respectively.

5.4.2 Sample Preservation and Storage

Tables 5-4 and 5-5 describe the sample preservation and storage requirements for solid and aqueous media, respectively. Samples will be preserved using appropriate preservatives in order to prevent or minimize chemical changes that could occur during transit and storage. Solid samples (soil and sediment) typically do not require preservation other than temperature control during storage and transfer to the laboratory. The exception is solid samples collected for analyses of volatile organic compounds, including volatile petroleum hydrocarbons (VPH) and target compound list (TCL) VOCs. Soil and sediment samples collected for analysis of VPH and TCL VOCs will be preserved in the field with methanol based on EPA SW-846 Method 5035.

5.4.3 Sample Holding Times

A holding time is defined as the allowable time between sample collection and analysis and/or extraction recommended to ensure accuracy and representativeness of analysis results, based on the nature of the analyte of interest and chemical stability factors. The holding time is calculated from the date and time of sample collection to the time of sample preparation and/or analysis. Sample holding times are established to minimize chemical changes in a sample prior to analysis and/or extraction. Samples will be shipped to the laboratory as soon as possible after collection or processing. There are currently no EPA guidelines for holding times for solid samples analyzed for metals/metalloids and most other inorganic constituents, but a six-month holding time is recommended. There is no holding time requirement for asbestos.

Tables 5-4 and 5-5 define method-specific analytical holding times for solid and aqueous media, respectively.

5.4.4 Sample Archival and Final Disposition

Unused samples and containers of environmental media will be maintained in storage at the laboratory for a minimum of 90 days following completion of the analysis, unless otherwise directed by EPA. Except as noted below, after 90 days or approval from EPA for disposal, the laboratory will be responsible for proper disposal of any remaining samples, sample containers,

shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

Materials that shall not be disposed of but held in archive include:

- unanalyzed portions of filters and grids that have been prepared for asbestos analysis. These shall be held in archive at the asbestos analytical laboratory.
- the archive portion and three fine-ground aliquots of sediment samples will be shipped from the soil preparation laboratory to the analytical laboratory, where these materials will be held in archive until otherwise directed by EPA.

All data generated during the analysis of project samples must be stored by the laboratory for a period of ten years. Revised copies of the applicable SOPs and QAPPs must also be maintained and available should the data be required.

5.5 Sample Documentation and Identification

Data regarding each sample collected will be documented in accord with OU3 SOP No. 9 using Libby-specific field sample data sheets (FSDS). Any special circumstances that influence sample collection or result in deviations from sampling SOPs will be documented in a field log book.

At the time of collection, each sample will be labeled with a unique 5-digit sequential identification (ID) number. The sample ID for all samples collected as part of Phase II sampling activities will have a prefix of "P2" (e.g., P2-12345). Information on whether the sample is representative of a field sample or a field-based quality control (QC) sample (e.g., field blank, field split) will be documented on the FSDS, but this information will not be included on the chain-of-custody to make certain that the sample type is unknown to the analytical laboratory.

Each field sampling team will maintain a field log book. The log book shall record all potentially relevant information on sampling activities and conditions that are not otherwise captured on the FSDS forms. Examples of the type of information to be captured in the filed log include:

- Names of team members
- Current and previous weather conditions
- Field sketches
- Physical description of the location relative to permanent landmarks
- Number and type of samples collected
- Any special circumstances that influenced sample collection

As necessary for sample collection and location documentation, photographs will be taken using a digital camera. GPS coordinates will be recorded for all sampling locations on the FSDS form. A stake or pole identifying the sampling station will be placed at or near the sampling station for future identification of the location.

5.6 Sample Chain of Custody and Shipment

Field sample custody and documentation will follow the requirements described in OU3 SOP No. 9. Sample packaging and shipping will follow the requirements described in OU3 SOP No. 8.

A chain-of-custody form specific to the Phase IIA OU3 sampling shall accompany every shipment of samples to the analytical laboratory. The purposes of the chain-of-custody form are: a) to establish the documentation necessary to track possession from the time of collection to final disposal; and b) to identify the type of analysis requested. All corrections to the chain-of-custody record will be initialed and dated by the person making the corrections. Each chain-of-custody form will include signatures of the appropriate individuals indicated on the form. The originals will accompany the samples to the laboratory and copies documenting each custody change will be recorded and kept on file. One copy of the chain-of-custody will be kept by field personnel.

All required paper work, including sample container labels, chain-of-custody forms, custody seals and shipping forms will be fully completed in ink (or printed from a computer) prior to shipping of the samples to the laboratory. Shipping to the appropriate laboratory from the field or sample storage will occur through overnight delivery.

All samples that may require special handling by laboratory personnel to prevent potential exposure to LA or other hazardous substances will be clearly labeled.

Upon receipt, the samples will be given to the laboratory sample custodian. The shipping containers will be opened and the contents inspected. Chain-of custody forms will be reviewed for completeness and samples will be logged and assigned a unique laboratory sample number. Any discrepancies or abnormalities in samples will be noted and the Laboratory Manger and the EPA Remedial Project Manager will be promptly notified.

Chain-of-custody will be maintained until final disposition of the samples by the laboratory and acceptance of analytical results.

6.0 LABORATORY ANALYSIS REQUIREMENTS

6.1 Analytical Methods for Asbestos

All laboratories that analyze samples of surface water or sediment for asbestos as part of this project must participate in and have satisfied the certification requirements in the last two proficiency examinations from the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NVLAP). Laboratories must also have demonstrated proficiency by successful analysis of Libby-specific performance evaluation samples and/or standard reference materials, and must participate in the on-going laboratory training program developed by the Libby laboratory team.

6.1.1 Routine Surface Water Analyses

Except as noted below (see Section 6.1.2), all surface water samples collected during Phase IIA sampling will be submitted for asbestos analysis using transmission electron microscopy (TEM) in accord with the International Organization for Standardization (ISO) 10312 method (ISO 1995) counting protocols, with all applicable Libby site-specific laboratory modifications, including the most recent versions of modifications LB-000016, LB-000019, LB-000028, LB-000029, LB-000030, and LB-000066 (as provided in Attachment C). An aliquot of water (generally about 100 mL) will be filtered through a 47 mm mixed cellulose acetate (MCE) filter with pore size of 0.2 um, using a backing filter with pore size of 5 um. All amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate Selective Area Electron Diffraction (SAED) patterns and Energy Dispersive X-Ray Analysis (EDXA) spectra, and having length $\geq$ 0.5 um and an aspect ratio (length:width) $\geq$ 3:1, will be recorded on the most recent version of the Libby site-specific laboratory bench sheets and electronic data deliverable (EDD) spreadsheets ("TEM Water EDD.xls"). Data recording for chrysotile, if observed, is not required.

The target analytical sensitivity for asbestos in water is 50,000 f/L (0.05 million fibers per liter, abbreviated as MFL). The human health maximum contaminant level (MCL) for asbestos in drinking water is 7,000,000 f/L and is based on fibers longer than 10 um in length. Upon review of available ecological toxicity data in the literature, it appears that effects thresholds range from about 10,000-1,000,000 f/L for aquatic receptors and wildlife. Therefore, a target analytical sensitivity of 50,000 f/L should be adequate to provide screening level risk estimates for humans and most ecological receptors of interest. This sensitivity can be achieved by filtering 100 mL of water and counting about 20 grid openings (GOs), assuming that filter overloading does not occur.

Stopping rules for these analyses are as follows:

1. Calculate the number of GOs needed to achieve the target sensitivity.

2. If the target sensitivity can be achieved by counting 50 or fewer GOs, count until the target sensitivity is achieved, or until 50 LA structures are observed. If 50 LA structures are observed, finish counting the GO containing the 50th structure, then stop.
3. If the target sensitivity requires more than 50 GOs, count until 50 GOs are counted, or until 50 LA structures are observed. If 50 LA structures are observed, finish counting the GO containing the 50th structure, then stop.

6.1.2 Special Surface Water Analyses

There are two groups of water samples for which the analytical requirements are different than for routine samples. These two special groups are described below, along with their special analytical requirements.

Group 1: Test of Fiber Suspension in Toxicity Testing Tanks

As described in Section 7, water from OU3 will be evaluated for toxicity to fish by testing in laboratory aquaria. For these tests to be considered reliable, it is important to demonstrate that LA fibers in the water remain suspended and are well mixed during the tests, and that fibers do not "settle out" during the exposure period.

A total of six water samples will be collected from a toxicity testing tank. These samples will be shipped from the toxicity testing laboratory under chain of custody to the following address:

EMSL Mobile Asbestos Lab
107 W 4th St.
Libby, MT 59923
(406) 293-9066

The date of shipment will be on a Monday, Tuesday or Wednesday.

Each of these six samples will be analyzed by ISO 10312 in accord with the following counting rules:

- Record each particle whose morphology is consistent with LA, whose SAED is consistent with amphibole asbestos, and whose EDS is consistent with LA, if the particle is at least 0.5 um long and has an aspect ratio of at least 3:1.
- Structures that intersect a non-countable grid bar (i.e., top and left grid bars) will not be counted.
- Structures that originate in one grid opening and extend into an adjacent grid opening will be counted, providing that they do not intersect a non-countable grid bar.
- Structures that intersect both a countable and a non-countable grid bar will be counted.

No other Libby-specific laboratory modifications apply to this effort.

Documentation will consist of the following:

- Record results using the form provided in Attachment D. Do not enter the data into the usual Libby EDD for water. These fast turnaround results will **not** be entered into the OU3 database.

- It is not necessary to record any EDS or photomicrographs as part of the fast turnaround analysis.

Stopping rules:

- Count each sample until 50 or more LA structures have been counted. Based on Monte Carlo simulations, this number of LA structures will allow more than a 90% probability of detecting a relative percent difference (RPD) of 50% and possibly less between the top and the bottom of the tank.

When the stopping rule is achieved, complete the last grid opening and stop.

Target turn around time will be within 3 days from receipt of samples to reporting of results to EPA.

Group 2: Quick Turn Around Analysis of Selected Element 2 Samples

As described in Section 7, water from OU3 will be evaluated for toxicity to fish by testing in laboratory aquaria. The goal is to collect the sample for toxicity testing from a location and at a time that represents the high end of the range of LA concentrations that occur in site water. Therefore, it is necessary to monitor LA concentrations in site water at several stations as a function of time in order to recognize where and when LA levels are near the maximum. These samples will be collected as part of Element 2. Since the rate of change in LA concentrations is not known, it is necessary to obtain analytical results as quickly as possible to allow EPA to direct Remedium Group, Inc. to collect surface water for toxicity testing from the optimum location and at the time when concentrations are likely to be highest.

Surface water samples for fast turn around analysis will be collected from four stations once per week, beginning approximately April 7, 2008 and extending to approximately May 12, 2008.

The analytical requirements for the fast turnaround samples from Element 2 are not as stringent as for other investigative samples because the goal is only to recognize where and when concentrations are reaching a maximum. All water samples analyzed under the fast turnaround program will also be analyzed at a later date in accord with standard analytical requirements, as specified in Section 6.1.1 (above).

Each Element 2 sample submitted for fast turnaround analysis will be analyzed by ISO 10312 in accord with the following counting rules:

- Record each particle whose morphology is consistent with LA, whose SAED is consistent with amphibole asbestos, and whose EDS is consistent with LA, if the particle is at least 0.5 um long and has an aspect ratio of at least 3:1.

- Structures that intersect a non-countable grid bar (i.e., top and left grid bars) will not be counted.

- Structures that originate in one grid opening and extend into an adjacent grid opening will be counted, providing that they do not intersect a non-countable grid bar.

- Structures that intersect both a countable and a non-countable grid bar will be counted.

No other Libby-specific laboratory modifications apply to this effort. Documentation will consist of the following:

- Record results using the form provided in Attachment D. Do not enter the data into the usual Libby EDD for water. These fast turnaround results will **not** be entered into the OU3 database. Rather, each sample will subsequently be analyzed in accord with standard methods specified in Section 6.1.1 and the results of those standard analyses will be reported as specified in Section 6.7 (below).

- It is not necessary to record any EDS or photomicrographs as part of the fast turnaround analysis.

Target analytical sensitivity will be 0.1 per 10^6 L (10^5 L^{-1}). This target is selected because it is expected that most samples tested will have concentrations in the range of 1-100 MFL. Surface waters with LA concentrations below this range will not be of interest in performing the toxicity testing. Based on an effective filter area of 1295 mm^2, and assuming that 100 mL of water is applied to the filter, this target sensitivity can be achieved by counting about 13 grid openings.

Stopping rules:

Count each sample until one of the following is achieved:

- The target sensitivity is achieved.

- 30 or more LA structures have been counted. Based on Monte Carlo simulations, this number of LA structures is sufficient to distinguish samples that differ in concentration by 50% in at least 90% of all trials.

When one of these requirements is achieved, complete the last grid opening and stop.

Target turn around time will be preferably 24 hours but no more than 48 hours from receipt of samples to reporting of results to EPA.

6.1.3 Sediment

Sample Preparation

All sediment samples collected for asbestos analysis will be transmitted to the CDM soil preparation laboratory in Denver, Colorado. Samples will be prepared in accordance with ISSI-LIBBY-01 Revision 10. In brief, the raw sediment sample is dried and then split into two aliquots. One aliquot is placed into archive, and the other aliquot is sieved into coarse (> ¼ inch) and fine fractions. The fine fraction is ground to reduce particles to a diameter of 250 um or less and this fine-ground portion is split into 4 aliquots.

Sample Analysis

Each sediment sample will be analyzed for LA in accordance with Libby site-specific SOPs. The coarse fraction (if any) will be examined using stereomicroscopy, and any particles of LA will be removed and weighed in accordance with SRC-LIBBY-01 Revision 2. One of the fine ground fraction aliquots will be analyzed by polarized light microscopy (PLM) using the visual area estimation method (PLM-VE) in accordance with SRC-LIBBY-03 Revision 2. Mass fraction estimates and optical property details will be recorded on the Libby site-specific laboratory bench sheets and EDD spreadsheets.

6.2 Analytical Methods for Other (Non-Asbestos) Analytes

This section describes the laboratory analysis methods selected to provide non-asbestos chemical data to support the Phase IIA data quality objectives. Methods employed are derived from the following sources:

- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (EPA, 1986)
- *Methods for Chemical Analysis of Water and Wastes* (EPA, 1994b)
- Montana Department of Environmental Quality method specifications for petroleum hydrocarbons (MDEQ, 2003)

Detailed calibration procedures and quality control practices associated with each referenced method are described later in Section 8.

The laboratories performing chemical analyses will be required to follow procedures for each referenced method in accordance with the method protocols in the original source documents.

All method-specific quality control measures, such as external and internal standard calibration procedures, instrument performance verifications, and quantitation using method of standard additions, specified within any referenced EPA method number will be performed.

6.2.1 Water

Non-asbestos analyses required for surface water samples are listed in Table 6-1. Analytes included under each method are identified in Table 3-1.

6.2.2 Sediment

Non-asbestos analyses required for surface water samples are listed in Table 6-2. Analytes included under each method are identified in Table 3-3.

6.3 Instrument Calibration and Frequency

All laboratory instruments used in the analysis of samples generated during this project must be calibrated by the laboratory in accordance with the requirements of the instrument manufacturer and the requirements specified in the relevant analytical method. Calibration records will be kept in logbooks for all instruments. It is the responsibility of the Laboratory Quality Assurance (QA) Officer to assure that calibration data is properly logged in the logbooks for each analysis.

6.4 Laboratory Custody Procedures and Documentation

The laboratories will implement the following procedures:

- A sample custodian will be designated.
- Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples.
- Enclosed chain-of-custody records will be cross-referenced with all the samples in the shipment. These records will be signed by the sample custodian and placed in the project file.
- Sample storage will be secured (in the appropriate environment, i.e., refrigerated, dry, etc.), sample storage records and intra-laboratory sample custody records will be maintained, and sample disposal and disposal date will be properly documented.
- Internal chain-of-custody procedures will be followed by assigning a unique laboratory number to each sample on receipt; this number identifies the sample through all further handling;
- Internal logbooks and records will maintain the chain-of-custody throughout sample preparation and analysis, and data reporting will be kept in the project files.
- The original chain-of-custody record will be returned to the Project QA Officer with the resulting data report from the laboratory.

It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, and data reporting.

6.5 Laboratory Health and Safety

All laboratories analyzing samples from OU3 must be properly trained in the safe handling, storage and disposal of samples that may contain LA and other potentially hazardous materials.

6.6 Documentation and Records

Data reports will be submitted to the Project Manager and include a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include signed chain-of-custody forms, analytical data summary report pages, and a summary of laboratory QC sample results and raw data, where applicable. Raw data are to consist of instrument preparation and calibration logs, instrument printouts of field sample results, laboratory QC sample results, calibration and maintenance records, chain-of-custody check in and tracking, raw data count sheets, spectra, micrographic photos, and diffraction patterns.

6.7 Data Deliverables

Asbestos data generated during this project will be entered into Libby-specific EDD spreadsheets by appropriately trained data entry staff. The data to be captured will include all relevant field information regarding each environmental sample collected, as well as the analytical results provided by the laboratory. Analytical results will include the structure-specific data for all TEM analyses and optical properties data for all PLM analyses. All data entry will be reviewed and validated for accuracy by the laboratory data entry manager or appointed delegate.

Non-asbestos data generated for this project will be transmitted via an EDD spreadsheet. The specific structure and format of this spreadsheet will be specified by the project data manager and will be provided to the laboratory for data submittal. All data entry will be reviewed and validated for accuracy by the laboratory data entry manager or appointed delegate.

All asbestos and non-asbestos EDDs will be submitted to EPA technical contractors (SRC) electronically. Whenever possible, data files should be transmitted by e-mail to the following address:

LibbyOU3@syrres.com

When files are too large to transmit by e-mail, they should be provided on compact disk to the following address:

Lynn Woodbury
Syracuse Research Corporation
999 18th Street, Suite 1975
Denver CO 80202

All original data records (both hard copy and electronic) will be cataloged and stored in their original form until otherwise directed by the EPA Remedial Project Manager. At the termination of the project, all original data records will be provided to the EPA Remedial Project Manager for incorporation into the OU3 project files.

7.0 TOXICITY TESTING REQUIREMENTS

This section provides a general description of the surface water toxicity testing protocol that will be implemented during Phase IIA. This design incorporates information and suggestions from the toxicity testing laboratory, Parametrix.

7.1 Part 1: Preliminary Test of Mixing

Because LA is a solid, it is necessary during the toxicity test to utilize a water circulation system that is sufficient to keep LA fibers suspended in the test waters. The following procedure will be performed before the tests with fish are begun in order to evaluate the efficacy of the water circulation method.

1. Remedium/MWH will collect a sample of about 5 gallons of water from the tailings impoundment and transmit this sample to the testing laboratory.
2. At the testing laboratory, Parametrix will place about 4 L of the water from the tailings impoundment containing LA into one 2.5 gallon aquarium and establish circulation conditions exactly as will be done during the toxicity test when fish are present.
3. After 3 days, remove three aliquots of 100 mL each from the top of the tank at a depth of about 1-2 cm below the surface of the water. Then, remove three aliquots of about 100 mL from a depth of about 0-2 cm above the bottom of the tank. Place each sample into a clean plastic bottle. Label these samples as follows:

Aliquot	Top	Bottom
1	Suspension Test Top-1	Suspension Test Bottom-1
2	Suspension Test Top-2	Suspension Test Bottom-2
3	Suspension Test Top-3	Suspension Test Bottom-3

4. Promptly transmit all bottles to the laboratory for analysis of LA. All samples will be counted using TEM until a minimum of 50 LA structures have been enumerated in each sample. This will allow more than a 90% probability of detecting a relative percent difference (RPD) of 50% between the top and the bottom of the tank.
5. If no statistically significant difference is detected, toxicity tests with fish may begin. If a significant difference is detected, then alternative methods for ensuring that LA fibers are well mixed throughout the tank will be investigated before testing begins.

7.2 Part 2: Toxicity Testing

Test Species

The test species will be rainbow trout (*Oncorhynchus mykiss*).

Life Stage

The life stage will be newly hatched larvae (sac fry).

Exposure Conditions

Exposure will be performed using a static renewal protocol in 2.5 gallon aquaria containing 4 L of water.

There will be 15 larvae per aquarium, with three aquaria per test water (a total of 45 larvae per test water).

Water temperature of test aquaria will be maintained at 12 ±1°C.

Exposure duration will be 6 weeks (42 days).

During the larval stage, water will be changed once every 10 days.

Swim-up is expected to occur on or about day 20 (after about 240 degree-days). After swim-up occurs, water will be changed once every three days.

Feeding

No feeding will occur during the larval stage.

After swim-up occurs, fish will be fed freshly-hatched brine shrimp (about 12 hours post hatch) daily at a rate of 0.05 grams of brine shrimp per gram of fish in the aquariums. The average mass of each fish as a function of time may be estimated from measurements on fish grown in parallel tanks, or from historical growth curves.

Test Water

One large volume (about 200 L or 50 gallons) of site water containing LA will be provided to the toxicity testing laboratory by Remedium/MWH. This water will be transmitted to the laboratory in a series of 5 gallon containers. Upon receipt at the laboratory, the containers will be combined into one large (≥ 50 gallon) container and thoroughly mixed. This water will be stored in the dark at 1-4°C prior to use in the tests in order to minimize the growth of algae or any other biological organisms.

Initial Characterization of the 100% Site Water

Aliquots of the 100% site water will be removed from the well-mixed 50 gallon holding tank and sent for analysis of the following analytes:

- LA asbestos: three 100 mL HDPE bottles sent to EMSL-Libby
- Metals and metalloids: two 8-oz glass bottles sent to Energy Laboratories

Rapid turnaround of the LA asbestos analysis of these samples is required. Analysis will be performed in accordance with the requirements described for Group 1 samples, described in Section 6.1.2. After rapid turnaround results are reported to EPA, the samples will be submitted for asbestos analysis using TEM in accord with the requirements described in Section 6.1.1.

Dilution Series

This test water will be tested for toxicity to fish at a series of dilutions. The 100% water stored in the 50-gallon holding tank must be thoroughly mixed before use each time water is used to prepare serial dilutions.

Assuming the starting concentration of LA in the site water is about 100 MFL total LA, the following dilutions will be used:

100% (undiluted)
10%
1%
0.1%
0.01%
0.001%
0%

These dilutions are selected based on the findings of Belanger (1985) that concentrations as low as 0.01 MFL of chrysotile caused observable effects in fish. In addition, it is important that the test waters include at least one concentration that represents a no-effect concentration (NOEC), since this is the most likely basis for a site-specific TRV.

Dilution Water

Dilutions of the site water shall be prepared using laboratory water that is prepared to have hardness, alkalinity (pH) and Ca/Mg ratio that are matched to the site water selected for toxicity testing. The toxicity laboratory will measure these water quality parameters in triplicate aliquots withdrawn from the well-mixed 50-gallon holding tank. For reference, water quality data from Phase I are summarized below:

Phase I Water Quality Parameters (mg/L)

Analyte	AVG	RANGE
Ca/Mg Ratio	3.8	1.7 - 6.6
Alkalinity, Total as CaCO3	300	120 - 485
Bicarbonate as HCO3	365	147 - 591
Carbonate as CO3	4.3	4.0 - 11
Hardness as CaCO3	313	124 - 464
Solids, Total Dissolved TDS @ 180 C	376	202 - 549
Solids, Total Suspended TSS @ 105 C	12	10 - 36
Organic Carbon, Dissolved (DOC)	4.0	1.2 - 15

Note that the water chemistry of the sample selected for testing may not be identical to these Phase I results.

Sampling of Serial Dilution Waters During the Test

For each round of static renewal, one composite sample of each dilution will be prepared by withdrawing and combining 33 mL from each of the three replicate test aquaria for each dilution. One composite per dilution will be collected shortly after the start of each renewal cycle, and one composite shall be collected at the end of the cycle shortly before performing the renewal. For convenience, the samples will be identified by the dilution level and the static renewal cycle number (see Table 7-1) and the designation "New" to indicate the sample taken at the start of the cycle and "Old" to designate the sample taken near the end of the cycle. These samples will be placed into 100 mL plastic bottles and stored in the dark at 4°C at the toxicity testing laboratory. EPA will designate samples that will be sent from the toxicity testing laboratory for analysis. Initially, the samples that will be sent for analysis of LA are as follows:

Cycle 1, Dilutions 1 to 7, new and old (N = 14)
Cycle 7, Dilutions 1 to 7, new and old (N = 14)

Routine Water Monitoring by the Laboratory

All test waters (including reference water) will be monitored in the laboratory for the following parameters:

Parameter	Frequency
Temperature	Daily
pH	Daily
Dissolved oxygen	Once per 5 days before swimup, and then at the start and end of each static renewal (every 3 days)
Ammonia	

Endpoints

Behavior

All aquaria will be observed daily for indications of differences in behavior between control fish and fish exposed to site waters. This may include, for example, differences in the frequency and duration of swimming events of the larvae, swimming and feeding behavior of the fry, etc. These observations will be recorded using the behavioral observation log sheet provided as Table 7-2.

Mortality

Observations on mortality will be recorded twice daily at approximately 8:30 AM and 4:30 PM. Table 7-3 provides the form that will be used for assigning a unique identifier to each fish and for recording date and time of death of each fish.

Histopathology

All fish that die during the study and all fish alive at the end of the study will be preserved by being placed into fixative solution for subsequent histopathological evaluation. Detailed SOPs for sample preservation, slide preparation, and histological examination will be provided by the histological laboratory. Based on the work of Belanger (1985), it is expected that relevant endpoints may include dermal thickening and abrasion, abrasion or lesions of the gill, as well as lesions of the kidneys and GI tract. However, the histologist should seek to identify any potentially meaningful changes that appear to be treatment-related.

Growth

No measures of growth will be performed during the larval stage. After swim-up, measures of growth will include length and mass of the fish at the time of death or at the end of the study. Data on growth will be recorded using the form provided in Table 7-3.

Data Reporting

For each water sample tested, the laboratory shall record data using forms that are approved by EPA. These forms will be similar to the data sheets provided in Tables 7-2 and 7-3. (EPA will provide the laboratory with electronic copies of these tables to facility data entry and transmittal). The laboratory shall also provide a text report in which the conditions of the test and any deviations from the study protocol or any other issues are described and evaluated.

8.0 QUALITY CONTROL

Quality Control (QC) is a component of the QAPP, and consists of the collection of data that allow a quantitative evaluation of the accuracy and precision of the field data collected during the project. QC samples that will be collected during this project include both field-based and laboratory-based QC samples.

8.1 Field-Based Quality Control Samples

Field-based QC samples are those samples which are prepared in the field and submitted to the laboratory in a blind fashion. That is, the laboratory is not aware the sample is a QC sample, and should treat the sample in the same way as a field sample. In general, there are three types of field QC sample: blanks, field splits/duplicates, and performance evaluation (PE) samples. Table 8-1 summarizes the types of field QC samples and frequency requirements the Phase IIA sampling program. Table 8-2 presents a summary of the number of expected field QC samples for surface water (Panel A) and sediment (Panel B) by element for the Phase IIA sampling program.

8.1.1 Blanks

Field Blanks

A field blank is a sample of the same medium as field samples, but which does not contain any contaminant. Field blanks are collected for water samples, but not for sediment.

A field blank for water shall be prepared by placing an appropriate volume of analyte-free reagent water (e.g., ASTM Type II) into a sample collection container. Field blanks for water will be collected at a rate of at least 10% (1 field blank per 10 field samples, or 1 per sample batch, whichever is greater).

Trip Blanks

The trip blank is used to indicate potential contamination of field samples by VOCs during sample shipping and handling. A trip blank consists of analyte-free laboratory reagent water which accompanies the empty sample bottles to the field and is placed in each cooler containing samples scheduled for VOC or EPH/VPH analysis. The trip blank is not opened until analysis in the laboratory with the corresponding site samples.

During Phase IIA sampling, one trip blank per cooler will be prepared to accompany aqueous samples when they are shipped to the laboratory for VOC analysis. One trip blank per cooler will also be prepared to accompany solid samples shipped for analysis of EPH and VPH.

Equipment Rinsate Blanks

Equipment rinsate blanks determine if decontamination procedures of field equipment are adequate to prevent cross-contamination of samples during sample collection. An equipment rinsate blank is prepared by rinsing decontaminated field equipment with analyte-free reagent water. Equipment rinsate blanks will be collected at a rate of 1 per sampling team per day. If field equipment is not re-used between sampling locations (i.e., dedicated equipment is used or equipment is disposable and decontamination is not necessary), equipment rinsate blanks will not be collected.

8.1.2 Field Splits/Duplicates

A field split is a sample that is prepared by thoroughly homogenizing a field sample, dividing the homogenized sample into two parts, and analyzing each independently. A comparison of field split samples is a measure of the precision of the sample preparation and analysis methods.

A field duplicate is a field sample that is collected at the same place and time as an original field sample. However, because of potential variation in field duplicate samples (even those from similar locations, especially for media such as sediment), it is not appropriate to assume that field duplicate pairs must necessarily have the same or similar concentration values. Rather, field duplicates help to evaluate variability due to small-scale media heterogeneity, along with analytical precision.

In general, field splits/duplicates will be prepared at a rate of approximately 10% (1 field split/replicate per 10 field samples). The specific stations at which field splits/duplicates will be collected will be determined in the field based on sampling conditions.

8.1.3 Performance Evaluation (PE) Samples

Performance Evaluation (PE) samples are samples of a matrix that contain a known and certified level of a contaminant. The results of PE sample analysis help evaluate analytical accuracy. PE samples for water and soil are available through the EPA Quality Assurance Technical Support (QATS) program. A total of 4 water PE samples and 3 soil PE samples containing a range of inorganic and organic analytes will be added in random order to the field samples by the field collection teams.

PE samples for LA in soil are available from USGS. These PE samples were prepared by mixing uncontaminated soil samples from Libby with known amounts of LA collected from the mine, so the true mass fraction of LA is known. A total of 4 PE samples representing a range of LA levels will be added to the sediment sample preparation and analysis train in random order at the time of sediment sample preparation by the preparation laboratory.

8.2 Laboratory-Based Quality Control Samples for Asbestos Analysis by TEM

The QC requirements for TEM analyses of air samples at the Libby site are patterned after the requirements set forth by NVLAP. There are three types of laboratory-based QC analyses that are performed for TEM. Each of these is described in more detail below.

Lab Blank - This is an analysis of a TEM grid that is prepared from a new, unused filter by the laboratory and is analyzed using the same procedure as used for field samples.

Recounts - A recount is an analysis where TEM grid openings are re-examined after the initial examination. The type of recount depends upon who is performing the re-examination. A *Recount Same* (RS) describes a re-examination by the same microscopist who performed the initial examination. A *Recount Different* (RD) describes a re-examination by a different microscopist within the same laboratory than who performed the initial examination. An *Interlab* (IL) describes a re-examination by a different microscopist from a different laboratory.

Repreparation - A repreparation is an analysis of a TEM grid that is prepared from a new aliquot of the same field sample as was used to prepare the original grid. Typically, this is done within the same lab as did the original analysis, but a different lab may also prepare grids from a new piece of filter.

As described the most recent Libby-specific Laboratory Modification #29 (LB-000029), laboratory blanks will be performed at a frequency of 4%, recounts will be performed at a frequency of 0.5% - 2.5% (depending upon the type of recount), and repreparations will be performed at a frequency of 1%. LB-000029 summarizes the project-specific acceptance criteria for TEM QC analyses for all participating laboratories.

For the purposes of the OU3 investigations, laboratory QC sample frequency requirements should be applied on a project-specific and medium-specific basis, rather than "across all media" as specified in LB-000029. Table 8-3 (Panel A) presents a summary of the number of expected laboratory QC samples for TEM analysis for the Phase IIA sampling program.

8.3 Laboratory-Based Quality Control Samples for Asbestos Analysis by PLM

8.3.1 Preparation Laboratory QC Samples

Sediment preparation QC samples are collected to ensure proper sample handling and decontamination of sediment preparation equipment. Preparation QC samples are assigned unique field identifiers and are submitted blind to the analytical laboratory along with the field samples. Thus, the analytical laboratories cannot distinguish field samples from preparation QC

samples. Two types of preparation QC samples are included for PLM analysis. Each of these is described in more detail below.

Preparation Blank – A preparation blank consists of asbestos-free quartz sand which is processed with each batch of field samples. A batch of samples is defined as a group of samples that have been prepared together for analysis at the same time (approximately 125). Preparation blanks determine if cross-contamination is occurring during sample preparation processing (i.e., drying, sieving, grinding, and splitting). The target number of preparation blanks is 1 per batch. All preparation blanks shall be PLM-VE Bin A (non-detect). If a preparation blank is ranked as a detect, the procedures for equipment decontamination between samples will be revised and revised as needed.

Preparation Splits – Preparation splits are prepared by dividing a sample into two parts after drying but prior to sieving and grinding. One preparation split is included for every 20 field samples prepared. Because preparation splits may be authentically different due to within-sample heterogeneity, there are no acceptance criteria for preparation splits. Comparison of the results for preparation splits with the paired original field samples helps to evaluate the variability that arises during the preparation and analysis steps.

Table 8-3 (Panel B) presents a summary of the number of expected preparation laboratory QC samples for PLM analysis for the Phase IIA sampling program.

8.3.2 Analytical Laboratory QC Samples

As part of PLM-VE analysis, laboratory duplicate analyses will be prepared at a frequency of 10% (1 per 10 analyses). A *laboratory duplicate* is a re-preparation of a soil sample slide by a different analyst than who performed the initial analysis. Laboratory duplicates are performed to evaluate potential analytical differences between analysts. The acceptance criterion for laboratory duplicate analyses is that no more than 10% of all samples shall be discordant (assigned different PLM-VE bins). If the discordance rate is greater than 10%, laboratory procedures for sample examination and bin-assignment shall be reviewed and staff re-trained, as needed.

Table 8-3 (Panel B) presents a summary of the number of expected analytical laboratory QC samples for PLM analysis for the Phase IIA sampling program.

8.4 Laboratory-Based Quality Control Samples for Non-Asbestos Analyses

The following subsections describe laboratory-based quality control measures used to assess and document the quality of analytical results for non-asbestos parameters. Laboratory QC sample analysis frequencies and control limits used by contracted laboratories will be in accordance with

referenced analytical method protocols, and the QC analyses and results will be documented and reported to EPA by the selected laboratory.

Table 8-4 summarizes all laboratory quality control measures, control limits, and corrective actions for this project, by analysis method. All laboratory QC data will be reported with results of associated sample analyses to allow for comparison of QC results to the QC criteria specified for this project.

8.4.1 Method Blank

Method blanks are designed to measure laboratory-introduced contamination of environmental samples. Method blanks verify that method interferences caused by airborne contaminants, solvents, reagents, glassware, or other sample processing hardware are known and minimized. The blank will be ASTM Type II water (or equivalent) for water samples. The method/reagent blank is processed through all procedures, materials, and lab-ware used for sample preparation and analysis.

The frequency for method blank preparation and analysis is a minimum of one per 20 field samples or per analytical batch, whichever is most frequent. An analytical batch is defined as samples which are analyzed together with the same method sequence and the same lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch are to be of similar composition or matrix.

Acceptance criteria and corrective action for out-of-control method blanks are provided in Table 8-4.

8.4.2 Laboratory Control Samples

Laboratory control samples (LCSs) are designed to check the accuracy of the analytical procedure by measuring a known concentration of an analyte of interest. LCS samples are prepared by spiking clean, laboratory-simulated matrices (reagent-free water or purified solid matrix) with representative analytes at known concentrations that are approximately 10 times greater than the method's quantitation limits. These spiked samples are then subjected to the same preparation and analytical procedures as associated environmental samples. A LCS will be analyzed with every analytical batch, and the measured concentrations will be compared to the known, or spiked, concentrations of the LCS to compute a percent recovery value.

LCSs will be analyzed at a minimum frequency of one per every 20 samples or one per analytical batch of no more than 20 samples. Control limits for laboratory control samples are listed on Table 8-4. Failure of the LCS to meet recovery criteria requires corrective action before any further analyses can continue.

For some methods, a duplicate of the LCS is also analyzed with each analytical batch and the difference between the LCS and the LCS Duplicate (LCSD) indicates the precision of laboratory sample preparation and analysis methods at a known concentration level. Control limits for precision measured by the RPD of LCS/LCSD results are listed in Table 8-4. When LCSD samples are analyzed, the minimum frequency of analysis is one per every 20 samples.

8.4.3 Matrix Spikes/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) samples are designed to evaluate the effect of the sample matrix on analytical data, by measuring precision and accuracy from a known concentration of a target analyte that has been added to a particular sample matrix. MS/MSD samples are prepared by spiking environmental field samples with a standard solution containing known concentrations of representative target analytes. The MS/MSD sample pair is prepared from three volumes of an environmental sample. Two portions of the sample (the MS and the MSD) are spiked with the standard solution. The remaining volume is not spiked. The spiked samples are analyzed, and the percent recovery (PR) and relative percent difference (RPD) between the results of the MS analysis and the MSD analysis are calculated. The unaltered sample volume is analyzed as an ordinary environmental sample.

Sampling personnel will identify for the laboratory which samples are to be used for MS/MSD preparation. Field blanks and field duplicates are not used as MS/MSDs. Typically, additional sample volume will be required to prepare the MS and MSD, especially for analyses of water samples for organic compounds. MS/MSDs will be analyzed at a minimum frequency of one per every 20 samples.

Background and interferences that have an effect on the actual sample analyte will have a similar effect on the spike. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method, i.e., sample preparation and analysis. The matrix spike is also a measure of the effect of the sample matrix on the ability of the methodology to detect specific analytes. Acceptance criteria and corrective action procedures for out-of-control matrix spike results are listed in Table 8-4.

8.4.4 Surrogate Spike Analyses

Surrogate spike analyses are used to determine the efficiency of target analyte recovery during sample preparation and analysis. A surrogate spike is prepared by adding a known amount of surrogate compound to an environmental sample before extraction. The surrogate compound is selected to exhibit an analytical response that is similar to the response displayed by a target compound during sample analysis. The accuracy of the analytical method is measured using the calculated percent recovery of the spiking compound. Poor reproducibility and percent recovery during surrogate spike analyses may indicate sample matrix effects.

Surrogate compounds are not added to inorganic analyses; however, surrogates are required for most organic analyses. Both environmental and QC samples are spiked with surrogate compounds. Surrogate spike recoveries are acceptable if the results of a surrogate spike fall within the control limits established by laboratory QC protocol. Acceptance criteria and corrective action procedures for out-of-control surrogate spike results are listed in Table 8-4.

Frequencies for surrogate spike analyses will be consistent with the referenced method protocols.

8.4.5 Internal Standards

Internal Standards (ISs) are compounds of known concentrations used to quantitate the concentrations of target detections in field and QC samples. ISs are added to all samples after sample extraction or preparation. Because of this, ISs provide for the accurate quantitation of target detections by allowing for the effects of sample loss through extraction, purging, and/or matrix effects. ISs are used for any method requiring an IS calibration. Corrective action is required when ISs are out of control. Acceptance criteria and corrective action procedures for out-of-control internal standard spike results are listed in Table 8-4.

8.4.6 Instrument Calibration and Frequency

Analytical instruments will be calibrated in accordance with the referenced analytical methods. All target analytes that are reported to EPA will be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in referenced methods. Records of standard preparation and instrument calibration will be maintained by the contract laboratory. Records will unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards will be traceable to standard materials.

Analyte concentrations are determined with either calibration curves (linear regression) or response factors (RFs). All correlation coefficients for linear regression calibration curves or relative standard deviation (RSD) of RFs to determine linearity must meet the acceptability criteria specified within the method. For GC/MS methods, the average RF from the initial five-point calibration will be used to determine analyte concentrations. The continuing calibration curve will not be used to update the RFs from the initial five-point calibration. GC/MS methods also will meet all instrument performance and/or tuning criteria as specified by the methods.

Initial Calibration Verification

Initial calibration curves must be verified using a standard made from a source independent of the one used to make the initial calibration standards. All target compounds must be included within the initial calibration verification (ICV), typically at a concentration around the midpoint

of the calibration curve. Control limits and corrective action procedures for out-of-control initial calibration verification results are listed in Table 8-4.

Continuing Calibration and Verification

Initial calibration curves must be verified daily prior to sample analysis. All target compounds must be included, typically at a concentration around the midpoint of the calibration curve. Continuing calibration verifications (CCVs) are check samples required at frequencies specified in each analytical method, typically at the beginning and end of each analytical sequence and after every ten samples analyzed (as specified in each analytical method). Control limits and corrective action procedures for out-of-control CCV results are listed Table 8-4.

Calibration procedures for a specific laboratory instrument will consist of initial calibration (3- or 5-points), initial calibration verification (ICV) and continuing calibration verification (CCV). Calibration protocols included in method references, including calibration frequencies, conditions, and acceptance criteria, will be followed.

8.5 Quality Assurance Objectives For Measurement Data

This section identifies specific objectives for precision, accuracy, representativeness, completeness, and comparability of measurement data collected to support the Phase IIA data quality objectives.

8.5.1 Precision

Precision is defined as the agreement between a set of replicate measurements without assumption or knowledge of the true value. Agreement is expressed as either the relative percent difference (RPD) for duplicate measurements, or the range and standard deviation for larger numbers of replicates. Precision will be assessed through the calculation of the relative percent difference (RPD) for two replicate samples. RPD is calculated according to the following formula:

$$RPD = \frac{(S - D)}{(S + D)/2} \cdot 100$$

where: S = Original sample value
D = Duplicate sample value

Field precision is assessed through the collection and measurement of field duplicates. The variability between field duplicates reflect the combined variation in concentration between nearby samples and the variation due to measurement error. Because the variability between

field duplicates is random and may be either small or large, no quantitative requirement for the agreement of field duplicates is established for this project.

Precision in the laboratory is assessed through calculation of RPDs for duplicate analyses or relative standard deviations (RSDs) for three or more replicate analyses of the same sample. Results from sediment duplicate samples are expected to be more variable than results from duplicate water samples due to the physical and chemical heterogeneity of the solid matrices. Based on this, an RPDs of 50% for sediment field duplicate samples and RPDs of 25% for water field duplicates will be used as advisory limits for analytes detected in both the original sample and its field duplicate at concentrations greater than 5 times the reported quantitation limit.

Differences greater than these advisory limits will be noted for data users through the data validation process.

8.5.2 Accuracy

Accuracy is a measure of the agreement between a measurement and the "true" value. The accuracy of a measurement may be affected by errors introduced by field contamination, sample preparation and handling, and sample analysis. The accuracy of an analytical method is generally assessed by analyses of samples with known concentration levels, including field calibration standards (for field based measurements), laboratory control samples, MS/MSD samples, and PE samples.

The accuracy required for data usability depends on a number of factors. In general, good accuracy is most important for samples whose concentration values are close to the level of concern, and a somewhat lesser level of accuracy may be acceptable for samples whose concentrations are either well below or well above a level of concern. Based on this, the goal is to achieve an analytical accuracy of ±25% for analytes that are within a factor of 10 of initial estimates of the level of concern, and ±50% for samples either 10-fold above or 10-fold below initial estimates of the level of concern.

8.5.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent characteristics of a population, parameter variations at a sampling point, or an environmental condition. Representativeness of field measurements is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the SAP and SOPs are followed. The sampling activities in this plan are designed to provide data that are representative of conditions at specific locations and times of sample collection.

8.5.4 Completeness

Data are considered complete when a prescribed percentage of the total intended measurements and samples are obtained. Analytical completeness is defined as the percentage of valid analytical results requested.

Field completeness is a measure of the amount of valid measurement data collected for the project. The target completeness objective for field measurements collected for this sampling program is 95% or more.

Laboratory completeness is a measure of the amount of valid laboratory-measurement data obtained for the project. For this sampling program, a minimum of 90% of the planned collection of individual samples for quantification must be obtained to achieve a satisfactory level of data completeness.

8.5.5 Comparability

Data are comparable if collection techniques, measurement procedures, methods, and reporting units are equivalent for the samples within a sample set. These criteria allow comparison of data from different sources. Comparable data will be obtained by specifying standard units for physical measurements and standard procedures for sample collection, processing, and analysis.

The criteria for field comparability will be to ensure and document that the sampling designs are properly implemented and the sampling procedures are consistently followed for the duration of the data collection program. Each sampling task will utilize standardized procedures for sample collection and field measurements, as specified in Section 5 of this plan.

The criteria for laboratory data comparability will be to ensure that the laboratory results generated during this phase of investigation will be comparable to laboratory data collected for all other environmental investigations at OU3 and comparable to the asbestos data already collected by EPA in the vicinity of OU3. This goal will be achieved through utilization of standard EPA Test Methods and site-specific asbestos analysis methods for sample analyses and adherence to quality assurance/quality control and analytical procedures specified for the OU3 RI.

9.0 DATA MANAGEMENT

9.1 Data Applications

All data generated as part of the Phase IIA sampling event will be maintained in an OU3-specific Microsoft Access® database. This will be a relational database with tables designed to store information on station location, sample collection details, preparation and analysis details, and analytical results. Results will include asbestos data (including detailed structure attributes for TEM analyses and optical properties for PLM analyses) and non-asbestos chemical data (e.g., metals.

9.2 Roles and Responsibilities for Data Flow

9.2.1 Field Personnel

W.R. Grace contractors will perform all Phase IIA sample collection in accordance with the project-specific sampling plan and SOPs presented above. In the field, sample details will be documented on hard copy media-specific FSDS forms and in field log books (see Section 5.5). COC information will be documented on hard copy forms (see Section 5.6). FSDS and COC information will be manually entered into a field-specific[3] OU3 database using electronic data entry forms. Use of electronic data entry forms ensures the accuracy of data entry and helps maintain data integrity. For example, data entry forms utilize drop-down menus and check boxes whenever possible. These features allow the data entry personnel to select from a set of standard inputs, thereby preventing duplication and transcription errors and limiting the number of available selections (e.g., media types). In addition, entry into a database allows for the incorporation of data entry checks. For example, the database will allow a unique sample ID to only be entered once, thus ensuring that duplicate records cannot be created.

Entry of FSDS forms and COC information will be completed weekly, or more frequently as conditions permit. Copies of all FSDS forms, COC forms, and field log books will be scanned and posted in portable document format (PDF) to a project-specific file transfer protocol (FTP) site weekly. This FTP site will have controlled access (i.e., user name and password are required) to ensure data access is limited to appropriate project-related personnel. File names for scanned FSDS forms, COC forms, and field log books will include the sample date in the format YYYYMMDD to facilitate document organization (e.g., FSDS_20070831.pdf). Electronic copies of all digital photographs will also be posted weekly to the project-specific FTP site. File names for digital photographs will include the station identifier, the sample date, and photograph identifier (e.g., ST-1_20070831_12459.tif).

[3] The field-specific OU3 database is a simplified version of the master OU3 database. This simplified database includes only the station and sample recording and tracking tables, as well as the FSDS and COC data entry forms.

After FSDS data entry is completed, a copy of the field-specific OU3 database will be posted by the field data manager to the project-specific FTP weekly, or more frequently as conditions permit. The field-specific OU3 database posted to the FTP site will include the post date in the file name (e.g., FieldOU3DB_20070831.mdb).

9.2.2 Laboratory Personnel

Each of the laboratories performing asbestos analyses for the Phase IIA sampling event are required to utilize all applicable Libby-specific Microsoft Excel® spreadsheets for asbestos data recording and electronic submittals (see Section 6.7). Upon completion of the appropriate analyses, EDDs will be transmitted via email to a designated email distribution list within the appropriate turn around time. Hard copies of all analytical laboratory data packages will be scanned and posted as a PDF to the project-specific FTP site. File names for scanned analytical laboratory data packages will include the laboratory name and the job number to facilitate document organization (e.g., LabX_12365-A.pdf).

9.2.3 Database Administrators

Day-to-day operations of the master OU3 database will be under the control of EPA contractors. The primary database administrator will be responsible for sample tracking, uploading new data, performing error checks, and making any necessary data corrections. New records will be added to the master OU3 database within an appropriate time period of FSDS and/or EDD receipt.

Incremental backups of the master OU3 database will be performed daily Monday through Thursday, and a full backup will be performed each Friday. The full backup tapes will be stored off-site for 30 days. After 30 days, the tape will be placed back into the tape library to be overwritten by another full backup.

9.3 Data Storage

All original data records (both hard copy and electronic) will be cataloged and stored in their original form until otherwise directed by the EPA Remedial Project Manager. At the termination of this project, all original data records will be provided to the EPA Remedial Project Manager for incorporation into the site project files.

10.0 ASSESSMENT AND OVERSIGHT

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities. Assessment, oversight reports, and response actions are discussed below.

10.1 Assessments

10.1.1 Field Oversight

All individuals who collect samples during field activities will be provided a copy of this SAP and will be required to participate in a pre-sampling readiness review meeting to ensure that methods and procedures called for in this SAP and associated SOPs are understood and that all necessary equipment is on hand. EPA may perform random and unannounced field audits of field sampling collection activities, as may be deemed necessary.

10.1.2 Laboratory Oversight

All laboratories selected for analysis of samples for asbestos will be part of the Libby analytical team. These laboratories have all demonstrated experience and expertise in analysis of LA in environmental media, and all are part of an on-going site-specific quality assurance program designed to ensure accuracy and consistency between laboratories. These laboratories are audited by EPA and NVLAP on a regular basis. Additional laboratory audits may be conducted upon request from the EPA, as may be needed.

10.2 Response Actions

If any inconsistencies or errors in field or laboratory methods and procedures are identified, response actions will be implemented on a case-by-case basis to correct quality problems. All response actions will be documented in a memo to the EPA RPM for OU3 at the following address:

Bonita Lavelle
U.S. EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129
E-mail: lavelle.bonita@epa.gov

Any problems that cannot be corrected quickly through routine procedures may require implementation of a corrective action request (CAR) form.

10.3 Reports to Management

Field and analytical staff will promptly communicate any difficulties or problems in implementation of the SAP to EPA, and may recommend changes as needed. If any revisions to this SAP are needed, the EPA RPM will approve these revisions before implementation by field or analytical staff.

11.0 DATA VALIDATION AND USABILITY

11.1 Data Validation and Verification Requirements

Data validation, review, and verifications must be performed on sample results before distribution to the public for review.

Validation of Non-Asbestos Data

For non-asbestos analytical data, data validation will be performed in accord with the most current versions of EPA's National Functional Guidelines. In brief, the validation process consists of examining the sample data package(s) in order to determine if the data comply with the requirements specified in the National Functional Guidelines. The validator may examine, as appropriate, the reported results, QC summaries, case narratives, COC information, raw data, initial and continuing instrument calibration, and other reported information to evaluate the accuracy and completeness of the data package. During this process, the validator will determine if analytical methodologies were followed and QC requirements were met. The validator may recalculate selected analytical results to verify the accuracy of the reported information, as appropriate, and will assign qualifiers to the data as needed.

Verification of Asbestos Data

For asbestos analytical data, data verification includes checking that all required data have been entered on the laboratory bench sheets and field sample data sheets, and that results have been transferred correctly to the EDD. Some of the data verification checks are performed as a function of built-in quality control checks in the Libby-specific data entry spreadsheets. Additional verifications of field and analytical results will be performed manually by independent review of the bench sheets and FSDS. The initial frequency of manual review will be 10% of all samples. This initial rate may be revised either upward or downward depending on the frequency and nature of errors that are identified by the verification process.

11.2 Reconciliation with Data Quality Objectives

Once all samples have been collected and the analytical data have been reported and validated, the data will be reviewed by data users to determine if DQOs were achieved.

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Table 3-1. Phase I Analytical Methods for Surface Water

Category	Method	Analytes			
Metals		Aluminum	Beryllium	Copper	Selenium
		Antimony	Cadmium	Lead	Silver
	SW6020 & SW	Arsenic	Chromium	Manganese	Thallium
	6010B	Barium	Cobalt	Nickel	Vanadium
		Boron	Iron	Potassium	Zinc
		Calcium	Magnesium	Sodium	
	SW7470A	Mercury			
Pesticides	SW8081A	4,4'-DDD	beta-BHC	Endosulfan sulfate	Heptachlor
		4,4'-DDE	Chlordane	Endrin	Heptachlor epoxide
		4,4'-DDT	delta-BHC	Endrin aldehyde	Isodrin
		Aldrin	Dieldrin	Endrin ketone	Methoxychlor
		alpha-BHC	Endosulfan I	gamma-BHC (Lindane)	Toxaphene
		alpha-Chlordane	Endosulfan II	gamma-Chlordane	
	SW8151A	2,4,5-T	Dalapon	MCPA	
		2,4,5-TP (Silvex)	Dicamba	MCPP	
		2,4-D	Dichlorprop	Pentachlorophenol	
Organophosphorus Pesticides	8141A	Dichlorvos	Diazinon	Chlorpyrifos	Stirophos (Tetrachlorovinphos)
		Mevinphos	Disulfoton	Trichloronate	Bolstar (Sulprofos)
		Demeton-O,S	Dimethoate	Methyl Parathion	Fensulfothion
		Ethoprop (Prophos)	Ronnel	Mathion	EPN
		Phorate	Merphos	Tokuthion (Prothiofos)	Azinphos-methyl (Guthion)
		Sulfotep	Fenthion	Ethyl Parathion	Coumaphos
PCBs	SW8082	Aroclor 1016	Aroclor 1242	Aroclor 1260	
		Aroclor 1221	Aroclor 1248	Aroclor 1262	
		Aroclor 1232	Aroclor 1254	Aroclor 1268	
VOCs	SW8260B	1,1,1-Trichloroethane	1,3-Dichlorobenzene	Chlorodibromomethane	Methyl isobutyl ketone
		1,1,2,2-Tetrachloroethane	1,4-Dichlorobenzene	Chloroethane	Methyl tert-butyl ether (MTBE)
		1,1,2-Trichloro-1,2,2-trifluoroethane	1,4-Dioxane	Chloroform	Methylcyclohexane
		1,1,2-Trichloroethane	2-Hexanone	Chloromethane	Methylene chloride
		1,1-Dichloroethane	Acetone	cis-1,2-Dichloroethene	o-Xylene
		1,1-Dichloroethene	Benzene	cis-1,3-Dichloropropene	Styrene
		1,2,3-Trichlorobenzene	Bromochloromethane	Cyclohexane	Tetrachloroethene
		1,2,4-Trichlorobenzene	Bromodichloromethane	Dichlorodifluoromethane	Toluene
		1,2-Dibromo-3-chloropropane	Bromoform	Ethylbenzene	trans-1,2-Dichloroethene
		1,2-Dibromoethane	Bromomethane	Isopropylbenzene	trans-1,3-Dichloropropene
		1,2-Dichlorobenzene	Carbon disulfide	m+p-Xylenes	Trichloroethene
		1,2-Dichloroethane	Carbon tetrachloride	Methyl acetate	Trichlorofluoromethane
		1,2-Dichloropropane	Chlorobenzene	Methyl ethyl ketone	Vinyl chloride
SVOCs	SW8270C	1,2,4,5-Tetrachlorobenzene	3,3'-Dichlorobenzidine	bis(-2-chloroethyl)Ether	Hexachlorocyclopentadiene
		2,3,4,6-Tetrachlorophenol	3-Nitroaniline	bis(2-chloroisopropyl)Ether	Hexachloroethane
		2,4,5-Trichlorophenol	4,6-Dinitro-2-methylphenol	bis(2-ethylhexyl)Phthalate	m+p-Cresols
		2,4,6-Trichlorophenol	4-Bromophenyl phenyl ether	Butylbenzylphthalate	Nitrobenzene
		2,4-Dichlorophenol	4-Chloro-3-methylphenol	Caprolactam	n-Nitroso-di-n-propylamine
		2,4-Dimethylphenol	4-Chlorophenyl phenyl ether	Carbazole	n-Nitrosodiphenylamine
		2,4-Dinitrophenol	4-Nitroaniline	Dibenzofuran	o-Cresol
		2,4-Dinitrotoluene	4-Nitrophenol	Diethyl phthalate	p-Chloroaniline
		2,6-Dinitrotoluene	Acetophenone	Dimethyl phthalate	Pentachlorophenol
		2-Chloronaphthalene	Atrazine	Di-n-butyl phthalate	Phenol
		2-Chlorophenol	Benzaldehyde	Di-n-octyl phthalate	
		2-Nitroaniline	Biphenyl	Hexachlorobenzene	
		2-Nitrophenol	bis(-2-chloroethoxy)Methane	Hexachlorobutadiene	
PAHs	SW8270C	2-Methylnaphthalene	Benzo(a)pyrene	Dibenzo(a,h)anthracene	Naphthalene
		Acenaphthene	Benzo(b)fluoranthene	Fluoranthene	Phenanthrene
		Acenaphthylene	Benzo(g,h,i)perylene	Fluorene	Pyrene
		Anthracene	Benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene	
		Benzo(a)anthracene	Chrysene	Isophorone	
Extractable hydrocarbons	MA-EPH	C11 to C22 Aromatics	C9 to C18 Aliphatics		
		C19 to C36 Aliphatics	Total Extractable Hydrocarbons		
	SW8015M	Total Extractable Hydrocarbons			
Volatile hydrocarbons	MA-VPH	C5 to C8 Aliphatics	Benzene	Methyl tert-butyl ether (MTBE)	
		C9 to C10 Aromatics	Ethylbenzene	Naphthalene	
		C9 to C12 Aliphatics	Toluene	m+p-Xylenes	
		Total Purgeable Hydrocarbons	Xylenes, Total	o-Xylene	
Nitrogen cmpds	E350.1	Nitrogen, Ammonia as N			
	E351.2	Nitrogen, Kjeldahl, Total as N			
	E353.2	Nitrogen, Nitrate+Nitrite as N			
	E353.2	Nitrogen, Nitrite as N	Nitrogen, Nitrate as N		
Radionuclides	E900.0	Gross Alpha			
	E903.0	Radium 226			
	RA-05	Radium 228			
	A7500-RA	Radium 226 + Radium 228			
Anions	E300.0	Chloride	Fluoride	Sulfate	
	E365.1	Orthophosphate as P			
	Kelada mod	Cyanide, Total			
Water quality parameters	A2320 B	Alkalinity, Total as CaCO3			
		Bicarbonate as HCO3			
		Carbonate as CO3			
		Hardness as CaCO3			
	A2540 C,D	Solids, Total Dissolved TDS	Solids, Total Suspended		
	A5310 C	Organic Carbon, Dissolved (DOC)			

Table 3-2. List of Phase I Surface Water Stations and Analyses

		Asbestos (LA)	Cations			Pesticides			PCBs	VOCs	SVOCs	PAHs	Petroleum Hydrocarbons		Nitrogen Compunds				Radionuclides				Anions			Water quality parameters		
			TAL Metals		Hg								Extractable HC	Volatile HC	NH4	Total N	N02+NO3	NO2	Gross α	Ra226	Ra228	Ra226+228	Cl. F. SO4	PO4	CN	HCO3,CO3	TDS	DOC
Reach	Station	EPA 100.2	SW6020	SW6010B	SW7470A	SW8081A	SW8151A	8141A	SW8082	SW8260B	SW8270C	SW8270C	MA-EPH	SW8015M	MA-VPH	E350.1	E351.2	E353.2	E353.2	E900.0	E903.0	RA-05	A7500-RA	E300.0	E365.1	Kelada	A2320.B	A2540C,D	A5310.C
Upper Rainy Creek	URC-1	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	URC-2	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
Tailings impoundment	TP	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	TP-TOE1	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	TP-TOE2	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
Mill pond	MP	X	X	X	X									X	X				X					X	X		X	X	X
Lower Rainy Creek	LRC-1	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	LRC-2	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	LRC-3	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	LRC-4	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	LRC-5	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	LRC-6	X	X	X	X									X	X	X	X	X	X					X	X		X	X	
Fleetwood Creek	FC-1	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
	FC-Pond	X	X	X	X							X	X	X	X	X	X	X	X					X	X		X	X	X
	FC-2	X	X	X	X									X	X	X	X	X	X					X	X		X	X	X
Carney Creek	CC-1	X	X	X	X									X	X				X					X	X		X	X	X
	CC-2	X	X	X	X									X	X				X					X	X		X	X	X
Seeps	CCS-1	X	X	X										X	X	X	X	X	X					X	X		X	X	X
	CCS-6	X	X	X	X									X	X				X					X	X		X	X	X
	CCS-8	X	X	X	X									X	X				X					X	X		X	X	X
	CCS-9	X	X	X	X									X	X				X					X	X		X	X	X
	CCS-11	X	X	X	X									X	X				X					X	X		X	X	X
	CCS-14	X	X	X	X							X	X	X	X				X					X	X		X	X	X
	CCS-16	X	X	X	X									X	X				X					X	X		X	X	X

X= Sample analyzed

Table 3-3. Phase I Analytical Methods for Sediment

Category	Method	Analytes			
Metals	SW6020 & SW6010B	Aluminum	Chromium	Selenium	
		Antimony	Cobalt	Silver	
		Arsenic	Copper	Thallium	
		Barium	Iron	Vanadium	
		Beryllium	Lead	Zinc	
		Boron	Manganese		
		Cadmium	Nickel		
	SW7471A	Mercury			
Cyanide	SW9012	Total cyanide			
Pesticides	SW8081A	4,4'-DDD	beta-BHC	Endosulfan sulfate	Heptachlor
		4,4'-DDE	Chlordane	Endrin	Heptachlor epoxide
		4,4'-DDT	delta-BHC	Endrin aldehyde	Isodrin
		Aldrin	Dieldrin	Endrin ketone	Methoxychlor
		alpha-BHC	Endosulfan I	gamma-BHC (Lindane)	Toxaphene
		alpha-Chlordane	Endosulfan II	gamma-Chlordane	
	SW8151A	2,4,5-T	Dalapon	MCPA	
		2,4,5-TP (Silvex)	Dicamba	MCPP	
		2,4-D	Dichlorprop	Pentachlorophenol	
Organophosphorus Pesticides	8141A	Dichlorvos	Diazinon	Chlorpyrifos	Stirophos (Tetrachlorovinphos)
		Mevinphos	Disulfoton	Trichloronate	Bolstar (Sulprofos)
		Demeton-O,S	Dimethoate	Methyl Parathion	Fensulfothion
		Ethoprop (Prophos)	Ronnel	Mathion	EPN
		Phorate	Merphos	Tokuthion (Prothiofos)	Azinphos-methyl (Guthion)
		Sulfotep	Fenthion	Ethyl Parathion	Coumaphos
PCBs	SW8082	Aroclor 1016	Aroclor 1242	Aroclor 1260	
		Aroclor 1221	Aroclor 1248	Aroclor 1262	
		Aroclor 1232	Aroclor 1254	Aroclor 1268	
VOCs	SW8260B	1,1,1-Trichloroethane	1,3-Dichlorobenzene	Chlorodibromomethane	Methyl isobutyl ketone
		1,1,2,2-Tetrachloroethane	1,4-Dichlorobenzene	Chloroethane	Methyl tert-butyl ether (MTBE)
		1,1,2-Trichloro-1,2,2-trifluoroethane	1,4-Dioxane	Chloroform	Methylcyclohexane
		1,1,2-Trichloroethane	2-Hexanone	Chloromethane	Methylene chloride
		1,1-Dichloroethane	Acetone	cis-1,2-Dichloroethene	o-Xylene
		1,1-Dichloroethene	Benzene	cis-1,3-Dichloropropene	Styrene
		1,2,3-Trichlorobenzene	Bromochloromethane	Cyclohexane	Tetrachloroethene
		1,2,4-Trichlorobenzene	Bromodichloromethane	Dichlorodifluoromethane	Toluene
		1,2-Dibromo-3-chloropropane	Bromoform	Ethylbenzene	trans-1,2-Dichloroethene
		1,2-Dibromoethane	Bromomethane	Isopropylbenzene	trans-1,3-Dichloropropene
		1,2-Dichlorobenzene	Carbon disulfide	m+p-Xylenes	Trichloroethene
		1,2-Dichloroethane	Carbon tetrachloride	Methyl acetate	Trichlorofluoromethane
		1,2-Dichloropropane	Chlorobenzene	Methyl ethyl ketone	Vinyl chloride
SVOCs	SW8270C	1,2,4,5-Tetrachlorobenzene	3,3'-Dichlorobenzidine	bis(-2-chloroethyl)Ether	Hexachlorocyclopentadiene
		2,3,4,6-Tetrachlorophenol	3-Nitroaniline	bis(2-chloroisopropyl)Ether	Hexachloroethane
		2,4,5-Trichlorophenol	4,6-Dinitro-2-methylphenol	bis(2-ethylhexyl)Phthalate	m+p-Cresols
		2,4,6-Trichlorophenol	4-Bromophenyl phenyl ether	Butylbenzylphthalate	Nitrobenzene
		2,4-Dichlorophenol	4-Chloro-3-methylphenol	Caprolactam	n-Nitroso-di-n-propylamine
		2,4-Dimethylphenol	4-Chlorophenyl phenyl ether	Carbazole	n-Nitrosodiphenylamine
		2,4-Dinitrophenol	4-Nitroaniline	Dibenzofuran	o-Cresol
		2,4-Dinitrotoluene	4-Nitrophenol	Diethyl phthalate	p-Chloroaniline
		2,6-Dinitrotoluene	Acetophenone	Dimethyl phthalate	Pentachlorophenol
		2-Chloronaphthalene	Atrazine	Di-n-butyl phthalate	Phenol
		2-Chlorophenol	Benzaldehyde	Di-n-octyl phthalate	
		2-Nitroaniline	Biphenyl	Hexachlorobenzene	
		2-Nitrophenol	bis(-2-chloroethoxy)Methane	Hexachlorobutadiene	
PAHs	SW8270C	2-Methylnaphthalene	Benzo(a)pyrene	Dibenzo(a,h)anthracene	Naphthalene
		Acenaphthene	Benzo(b)fluoranthene	Fluoranthene	Phenanthrene
		Acenaphthylene	Benzo(g,h,i)perylene	Fluorene	Pyrene
		Anthracene	Benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene	
		Benzo(a)anthracene	Chrysene	Isophorone	
Extractable hydrocarbons	MA-EPH	C11 to C22 Aromatics	C9 to C18 Aliphatics		
		C19 to C36 Aliphatics	Total Extractable Hydrocarbons		
	SW8015M	Total Extractable Hydrocarbons			
Volatile hydrocarbons	MA-VPH	C5 to C8 Aliphatics	Benzene	Methyl tert-butyl ether (MTBE)	
		C9 to C10 Aromatics	Ethylbenzene	Naphthalene	
		C9 to C12 Aliphatics	Toluene	m+p-Xylenes	
		Total Purgeable Hydrocarbons	Xylenes, Total	o-Xylene	
Anions	E300.0	Fluoride			
	E365.1	Total Phosphorus			
Sediment quality parameters	ASAM10-3.2	pH, sat. paste			
	SW3550A	Moisture			
	Leco	Carbon, Organic			

Table 3-4. List of Phase I Sediment Stations and Analyses

		Asbestos (LA)		Cations			Cyanide	Pesticides			PCBs	VOCs	SVOCs	PAHs	Petroleum Hydrocarbons			Anions		Sediment quality parameters		
				TAL Metals		Hg									Extractable HC		Volatile HC	Fluoride	Phosphorus	pH	Moisture	OC
Reach	Station	PLM-VE	PLM-GRAV	SW6020	SW6010B	SW7471A	SW9012	SW8081A	SW8151A	8141A	SW8082	SW8260B	SW8270C	SW8270C	MA-EPH	SW8015M	MA-VPH	E300.0	E365.1	ASAM10-3.2	SW3550A	Leco
Upper Rainy Creek	URC-1	X		X	X	X								X	X	X	X	X	X	X	X	X
	URC-2	X	X	X	X	X								X	X	X	X	X	X	X	X	X
Tailings impoundment	TP	X	X	X	X	X								X	X	X	X	X	X	X	X	X
	TP-TOE1	X	X	X	X	X										X	X	X	X	X	X	X
	TP-TOE2	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
Mill pond	MP	X		X	X	X								X	X	X	X	X	X	X	X	X
Lower Rainy Creek	LRC-1	X	X	X	X	X		X	X		X					X	X	X	X	X	X	X
	LRC-2	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
	LRC-3	X		X	X	X		X	X		X			X	X	X	X	X	X	X	X	X
	LRC-4	X		X	X	X		X	X		X					X	X	X	X	X	X	X
	LRC-5	X	X	X	X	X		X	X		X					X	X	X	X	X	X	X
	LRC-6	X		X	X	X		X	X		X			X	X	X	X	X	X	X	X	X
Fleetwood Creek	FC-1	X	X	X	X	X										X	X	X	X	X	X	X
	FC-Pond	X		X	X	X								X	X	X	X	X	X	X	X	X
	FC-2	X	X	X	X	X								X	X	X	X	X	X	X	X	X
Carney Creek	CC-1	X	X	X	X	X								X	X	X	X	X	X	X	X	X
	CC-2	X	X	X	X	X										X	X	X	X	X	X	X
Seeps	CCS-1	X		X	X	X										X	X	X	X	X	X	X
	CCS-6	X	X	X	X	X										X	X	X	X	X	X	X
	CCS-8	X	X	X	X	X								X	X	X	X	X	X	X	X	X
	CCS-9	X	X	X	X	X										X	X	X	X	X	X	X
	CCS-11	X	X	X	X	X								X	X	X	X	X	X	X	X	X
	CCS-14	X	X	X	X	X										X	X	X	X	X	X	X
	CCS-16	X		X	X	X								X	X	X	X	X	X	X	X	X

X = Sample analyzed

Table 3-5. Phase I Asbestos Results for Surface Water

Reach	Station	Sensitivity 1E 06/L	Total LA (MFL)				LA > 10 um in Length (MFL)			
			LA Count	Best Estimate	95% Conf. Bounds		LA Count	Best Estimate	95% Conf. Bounds	
Upper Rainy Creek	URC-1	0.05	0	<0	0.0	0.1	0	<0.05	0.0	0.1
	URC-2	0.11	52	5.8	4.3	7.5	1	0.1	0.0	0.5
Tailings Impoundment	TP	1.99	57	114	86.9	146.0	19	38	23.6	57.9
	TP-TOE1	0.05	0	<0.1	0.0	0.1	0	<0.05	0.0	0.1
	TP-TOE2	0.20	10	2.0	1.0	3.5	6	1.2	0.5	2.5
Mill Pond	MP	0.50	54	27	20.4	34.8	20	10	6.3	15.1
Lower Rainy Creek	LRC-1	0.05	4	0.2	0.1	0.5	0	<0.05	0.0	0.1
	LRC-2	0.05	2	0.1	0.0	0.3	1	0.05	0.0	0.2
	LRC-3	0.05	4	0.2	0.1	0.5	0	<0.05	0.0	0.1
	LRC-4	0.05	21	1.0	0.7	1.6	3	0.2	0.0	0.4
	LRC-5	0.05	25	1.2	0.8	1.8	2	0.1	0.0	0.3
	LRC-6	0.05	0	<0.1	0.0	0.1	0	<0.05	0.0	0.1
Fleetwood Creek	FC-1	0.08	51	3.9	2.9	5.1	12	0.9	0.5	1.6
	FC-Pond	2.49	50	125	93.5	162.7	3	7.5	2.1	19.9
	FC-2	0.05	4	0.2	0.1	0.5	1	0.05	0.0	0.2
Carney Creek	CC-1	0.05	20	0.9	0.6	1.4	7	0.3	0.1	0.7
	CC-2	0.05	1	0.00	0.0	0.2	1	0.05	0.0	0.2
Seeps	CCS-9	0.05	0	<0.1	0.0	0.1	0	<0.05	0.0	0.1
	CCS-8	0.05	0	<0.1	0.0	0.1	0	<0.05	0.0	0.1
	CCS-6	1.99	50	100	74.8	130.2	2	4.0	0.8	12.8
	CCS-1	0.14	53	7.5	5.7	9.8	3	0.4	0.1	1.1
	CCS-11	0.33	50	17	12.5	21.7	10	3.3	1.7	5.9
	CCS-14	0.20	55	11	8.3	14.2	0	<0.2	0.0	0.5
	CCS-16	0.08	0	<0.1	0.0	0.2	0	<0.08	0.0	0.2

Table 3-6. Phase I Asbestos Results for Sediment

Reach	Station	Index ID	MASS (grams)		RESULTS	
			Fine Fraction	Coarse Fraction	$MF_{LA\%}$ fine	$MF_{LA\%}$ coarse
Upper Rainy Creek	URC-1	P1-00409	137.7	0	ND	--
	URC-2	P1-00408	123.1	47.9	<1%	Tr
Tailings Impoundment	TP	P1-00407	100.2	6.6	<1%	Tr
	TP-TOE1	P1-00326	142.2	30.6	2%	0.38%
	TP-TOE2	P1-00325	183.2	29	3%	0.03%
Mill Pond	MP	P1-00348	166.7	0	<1%	--
Lower Rainy Creek	LRC-1	P1-00338	210.9	44.7	<1%	0.13%
	LRC-2	P1-00336	256.9	36.2	<1%	Tr
	LRC-3	P1-00335	98.86	0	2%	--
	LRC-4	P1-00329	137.8	0	<1%	--
	LRC-5	P1-00328	129.8	35	<1%	Tr
	LRC-6	P1-00327	183.5	0	<1%	--
Fleetwood Creek	FC-2	P1-00406	203.7	14.3	Tr	ND
	FC-Pond	P1-00405	89.2	0	<1%	--
	FC-1	P1-00404	200.9	31.2	ND	ND
Carney Creek	CC-2	P1-00399	153.9	37.4	<1%	0.20%
	CC-1	P1-00395	126.1	28.6	4%	0.52%
Seeps	CCS-9	P1-00400	111.9	8.7	7%	Tr
	CCS-8	P1-00398	75.6	33.6	6%	0.41%
	CCS-6	P1-00397	163.9	21.8	2%	Tr
	CCS-1	P1-00396	170.2	53.3	2%	Tr
	CCS-11	P1-00402	183.3	26.4	<1%	0.20%
	CCS-14	P1-00403	129.6	4.1	<1%	Tr
	CCS-16	P1-00289	119	0	4%	--

Table 3-6 LA in Sed.xls, Sediment

TABLE 3-7. PHASE I NON-ASBESTOS RESULTS FOR SURFACE WATER

Category	Detected Analytes	Units	Detection Frequency (DF)	Mean Detection Limit (DL)	Concentration	
					Mean[1]	Max
Metals[†]	Barium	mg/L	24 / 24 100%	na	0.47	1.00
	Copper	mg/L	1 / 24 4%	0.002	0.0011	0.004
	Iron	mg/L	3 / 24 13%	0.03	0.071	1.34
	Manganese	mg/L	5 / 24 21%	0.02	0.045	0.66
	Vanadium	mg/L	1 / 24 4%	0.01	0.0052	0.01
	Calcium	mg/L	24 / 24 100%	na	82	131
	Magnesium	mg/L	24 / 24 100%	na	24	49
	Potassium	mg/L	24 / 24 100%	na	13	33
	Sodium	mg/L	24 / 24 100%	na	8	15
Volatile Hydrocarbons	Benzene	ug/L	1 / 24 4%	0.5	0.27	0.65
	C5 to C8 Aliphatics	ug/L	3 / 24 13%	20	13.6	62
	TPH	ug/L	3 / 24 13%	20	13.0	53
Extractable Hydrocarbons	TEH	mg/L	2 / 24 8%	0.30	0.17	0.47
Nitrogen Compounds	Nitrate	mg/L	10 / 15 67%	0.01	0.1	1.2
	Nitrite	mg/L	1 / 24 4%	0.01	0.0	0.01
Radionuclides	Gross Alpha	pCi/L	2 / 2 100%	na	2.1	2.5
Anions	Chloride	mg/L	22 / 24 92%	1	4.5	10
	Fluoride	mg/L	24 / 24 100%	na	0.4	0.9
	Sulfate	mg/L	24 / 24 100%	na	19.9	58
	PO4	mg/L	24 / 24 100%	na	0.2	1.16
Water Quality Parameters	Hardness as CaCO3	mg/L	20 / 20 100%	na	307	464
	Carbonate as CO3	mg/L	2 / 24 8%	4	2.5	11
	TDS	mg/L	24 / 24 100%	na	371	549
	TSS	mg/L	4 / 24 17%	10	7.8	36
	DOC	mg/L	23 / 23 100%	na	4.1	15

na = not applicable, all samples detected
TPH = Total Purgeable Hydrocarbons
TEH = Total Extractable Hydrocarbons
[†]Data presented in this table are based on the dissolved fraction for metals
[1] Mean calculated assuming 1/2 DL for NDs

TABLE 3-8. PHASE I NON-ASBESTOS RESULTS FOR SEDIMENT

Category	Detected Analytes	Detection Frequency (DF)	Mean Detection Limit (DL) (mg/kg)	Concentration (mg/kg)	
				Mean[a]	Max
Metals	Aluminum	24 / 24 100%	na	12,419	33,800
	Arsenic	10 / 24 42%	2.00	2.1	7
	Barium	24 / 24 100%	na	844	4,930
	Chromium	24 / 24 100%	na	149	988
	Cobalt	23 / 24 96%	5.00	18	75
	Copper	24 / 24 100%	na	31	66
	Iron	24 / 24 100%	na	21,817	54,600
	Lead	23 / 24 96%	5.00	27	100
	Manganese	24 / 24 100%	na	1,240	12,700
	Mercury	2 / 24 8%	0.10	0.1	0.1
	Nickel	23 / 24 96%	5.00	37	226
	Selenium	4 / 24 17%	0.50	0.4	1.4
	Thallium	3 / 24 13%	0.60	0.5	4.3
	Vanadium	24 / 24 100%	na	45	105
	Zinc	24 / 24 100%	na	27	54
PAH	Pyrene	1 / 14 7%	0.87	0.4	1.2
VOC	Methyl acetate	2 / 2 100%	na	0.3	0.4
Extractable Hydrocarbons	C11 to C22 Aromatics	4 / 12 33%	24.41	63	436
	C19 to C36 Aliphatics	4 / 12 33%	25.63	71	350
	C9 to C18 Aliphatics	2 / 12 17%	26.40	28	162
	Total Extractable Hydrocarbons (MA-EPH)	4 / 12 33%	25.13	188	1,240
	Total Extractable Hydrocarbons (SW8015M)	23 / 24 96%	9.80	176	928
Volatile Hydrocarbons	C9 to C10 Aromatics	1 / 24 4%	3.86	2.3	10
	C9 to C12 Aliphatics	1 / 24 4%	3.95	2.0	10
	Total Purgeable Hydrocarbons	3 / 24 13%	3.65	2.9	17
Anions	Fluoride	5 / 24 21%	1.00	0.9	4.1
	Total Phosphorus	24 / 24 100%	na	2,564	10,200
Sediment Quality Parameters	pH, sat. paste	24 / 24 100%	na	7.2	8
	Moisture	24 / 24 100%	na	39.9	86
	Carbon, Organic	24 / 24 100%	na	2.5	15

na = not applicable

[a] Mean calculated assuming 1/2 DL for NDs

Table 3-9. Phase I Surface Water Flow Data

Station ID	Date	Time	Flow (ft^3/sec)	Flow (gal/min)
URC-1	10/18/2007	12:00	0.09	39
URC-2	10/18/2007	11:30	0.04*	20*
TP-TOE1	10/18/2007	12:20	0.29	132
TP-TOE2	10/18/2007	12:35	0.58	259
LRC-1	10/18/2007	12:15	0.41	184
LRC-2	10/18/2007	11:55	0.50	224
LRC-3	10/18/2007	11:33	0.76	341
LRC-4	10/18/2007	11:12	0.34	153
LRC-5	10/18/2007	10:50	0.63	283
LRC-6	10/18/2007	10:44	0.41	184
FC-1	10/18/2007	10:45	0.14	65
FC-2	10/18/2007	11:10	0	0
CC-1	10/18/2007	10:15	0.07	30
CC-2	10/18/2007	10:00	0.19	84

*Flow was observed at less than 19 gallons per minute with 5% leakage.
After adjusting for leakage a value of 20 gallons per minute was estimated.

TABLE 4-1. PROJECTED NUMBER OF SURFACE WATER SAMPLES

EXPOSURE UNIT	STATION	ASBESTOS (LA)			NON-ASBESTOS					
					Analytical Suite 1			Analytical Suite 2		
		P1	P2A[a]	Total	P1	P2A[a]	Total	P1	P2A[a]	Total
Upper Rainy Creek	URC-1	1	2	28	1	2	8			
	URC-1A		12			2				
	URC-2	1	12		1	2				
Tailings Impoundment	TP-Overflow		12	43		2	11			3
	TP+UTP	1	14		1	2				
	TP-TOE1	1	12		1	2		1	2	
	TP-TOE2	1	2		1	2				
Mill Pond	MP	1	12	13	1	2	3			
Lower Rainy Creek	LRC-1	1	12	62	1	2	18			3
	LRC-2	1	19		1	2		1	2	
	LRC-3	1	2		1	2				
	LRC-4	1	2		1	2				
	LRC-5	1	2		1	2				
	LRC-6	1	19		1	2				
Fleetwood Creek	FC-1	1	2	19	1	2	9			
	FC-Pond	1	2		1	2				
	FC-2	1	12		1	2				
Carney Creek	CC-1	1	2	28	1	2	8			
	CC-2	1	12		1	2				
	CC-Pond		12			2				
Seeps	CCS-9	1	2	21	1	2	21			
	CCS-8	1	2		1	2				
	CCS-6	1	2		1	2				
	CCS-1	1	2		1	2				
	CCS-11	1	2		1	2				
	CCS-14	1	2		1	2				
	CCS-16	1	2		1	2				
Kootenai River	UKR		2	18						
	KR-1		2							
	KR-2		2							
	KR-3		2							
	KR-4		2							
	KR-5		2							
	KR-6		2							
	KR-7		2							
	KR-8		2							

[a] Approximate number of samples to be collected (may vary based on field conditions at the time of sampling).

LA = Libby amphibole
P1 = Phase I
P2A = Phase IIA

Suite 1 = Partial analytical suite (may include metals/metalloids, petroleum hydrocarbons, nitrogen compounds, cations/anions, and water quality parameters).

Suite 2 = Full analytical suite (may include metals/metalloids, pesticides, PCBs, VOCs, SVOCs, PAHs, petroleum hydrocarbons, nitrogen compounds, radionuclides, cations/anions, and water quality parameters).

TABLE 4-2. PROJECTED NUMBER OF SEDIMENT SAMPLES

EXPOSURE UNIT	STATION	ASBESTOS			NON-ASBESTOS					
		LA			Analytical Suite 1			Analytical Suite 2		
		P1	P2A[a]	Total	P1	P2A[a]	Total	P1	P2A[a]	Total
Upper Rainy Creek	URC-1	1	2	8	1	2	8			
	URC-1A		2			2				
	URC-2	1	2		1	2				
Tailings Impoundment	TP+UTP	1	17	24	1	17	24			3
	TP-TOE1	1	2		1	2				
	TP-TOE2	1	2		1	2		1	2	
Mill Pond	MP	1	5	6	1	5	6			
Lower Rainy Creek	LRC-1	1	2	18	1	2	18	1	2	18
	LRC-2	1	2		1	2		1	2	
	LRC-3	1	2		1	2		1	2	
	LRC-4	1	2		1	2		1	2	
	LRC-5	1	2		1	2		1	2	
	LRC-6	1	2		1	2		1	2	
Fleetwood Creek	FC-1	1	2	12	1	2	12			
	FC-Pond	1	5		1	5				
	FC-2	1	2		1	2				
Carney Creek	CC-1	1	2	11	1	2	11			
	CC-2	1	2		1	2				
	CC-Pond		5			5				
Seeps	CCS-9	1	2	21	1	2	21			
	CCS-8	1	2		1	2				
	CCS-6	1	2		1	2				
	CCS-1	1	2		1	2				
	CCS-11	1	2		1	2				
	CCS-14	1	2		1	2				
	CCS-16	1	2		1	2				
Kootenai River	UKR		1	6						
	North Bank		3							
	Sand Bar		2							

[a] Approximate number of samples to be collected (may vary based on field conditions at the time of sampling).

LA = Libby amphibole
P1 = Phase I
P2A = Phase IIA
Suite 1 = Partial analytical suite (may include metals/metalloids, PAHs, petroleum hydrocarbons, cations/anions, and sediment quality parameters).
Suite 2 = Full analytical suite (may include metals/metalloids, pesticides, PCBs, PAHs, VOCs, SVOCs, petroleum hydrocarbons, cations/anions, and sediment quality parameters).

Table 5-1. Libby OU3 Phase IIA Surface Water and Sediment Sampling Program Elements

Part A. Rainy Creek Watershed

	Program Element	Goal	Medium	Sampling Locations	Sampling Medium/ Frequency/Duration	Sample Type	Chemical Analytes	Field Measures
1	Seasonal Monitoring	Characterize conditions at multiple stations, as a function of season	Surface water	Same as Phase I plus URC-1A, UTP (2 depths), and CC-Pond	Spring (one sample) Summer (one sample)	Grab	Same as Phase I	Flow
			Sediment	Same as Phase I plus URC-1A and multiple samples from ponds (CC-Pond, FC-Pond, MP, TP)	Late spring after peak runoff (one sample) Summer (one sample)	Grab	Same as Phase I	---
2	Spring Runoff Monitoring	Evaluate changes in water quality during rising and falling limbs of Spring snowmelt-runoff hydrograph	Surface water	FC-2 FC-Pond* URC-2 URC-1A TP TP-TOE1 TP-Overflow (if flowing) CC-2 CC-Pond LRC-1 LRC-2 LRC-6 MP	Once per week One sample before rise in hydrograph to establish baseline. Once rise begins, weekly until 4 weeks past peak (may be adjusted based on field observation)	Grab	Asbestos	Flow
3	Summer-fall monitoring	Continue measurements from Element 2, but reduce stations and frequency	Surface water	LRC-2 LRC-6	Beginning with cessation of Element 2, once per two weeks plus 3 storm events until September 30	24-hour flow-weighted composite with auto sampler	Asbestos	Flow
4	Continuous Flow Monitoring	Characterize spring-snowmelt hydrograph. Use flow data with asbestos data to characterize asbestos loads.	Surface water	LRC-2 LRC-6 CC-2	LRC-2 and LRC-6 Begin approx. March 1 and end September 30 CC-2 During spring runoff period only (see Element 2)	Continuous data logger (install flume and automated monitoring equipment).	---	Flow
5	Water collection for toxicity testing	Establish site-specific TRV for asbestos	Surface water	One location; to be determined	Once (max concentration)	Approx 150 L	Asbestos TAL metals	

* Sample collection will be suspended after selection of the surface water toxicity test location

Table 5-1. Libby OU3 Phase IIA Surface Water and Sediment Sampling Program Elements
(continued)

II. Part B: Kootenai River

Sampling Program Element		Goal	Medium	Sampling Locations	Sampling Medium Frequency/Duration	Sample Type	Analytes
1	Kootenai River Sampling	Evaluate asbestos levels in river water (and sediment) near mine area.	Water	Mid-river upstream (1 location); Transect across river downstream of Rainy Creek (5 locations just downstream of sandbar); Along north bank downstream of Rainy Creek (3 locations)	Once at time of Rainy Ck peak snowmelt-runoff flow One time in summer	Grab	Asbestos
			Sediment	One sample in depositional area along north bank, upstream of Rainy Creek; 2-3 samples from depositional areas along north bank, downstream of Rainy Creek, within 1/2 mile; Two borings (stratified by depth) from the large sandbar mid-channel, downstream of Rainy Creek	One time in summer	Grab Grab Boring to water	Asbestos

Table 5-2
Phase IIA Surface Water/Sediment Sampling Locations
in the Rainy Creek Watershed

Station ID	Description
URC-1	Upper Rainy Creek above Mine Area
URC-1A	Upper Rainy Creek above Mine Area 100 yards north of Rainy Creek Rd.
URC-2	Upper Rainy Creek above Mine Area
LRC-1	Lower Rainy Creek above confluence with Carney Creek
LRC-2	Lower Rainy Creek below confluence with Carney Creek
LRC-3	Lower Rainy Creek
LRC-4	Lower Rainy Creek
LRC-5	Lower Rainy Creek
LRC-6	Lower Rainy Creek just above confluence with the Kootenai River
FC-1	Fleetwood Creek above Mine Area
FC-2	Fleetwood Creek above Tailings Impoundment
FC-Pond	Pond on Fleetwood Creek
UTP	Upper Tailings Impoundment
TP	Tailings Impoundment
TP-TOE1	Toe drain of impoundment
TP-TOE2	Toe drain flow to Rainy Creek below diversion
TP-Overflow*	In the overflow ditch from tailings impoundment
MP	Mill Pond
CC-1	Carney Creek
CC-2	Carney Creek just above confluence with Rainy Creek
CC-Pond	Pond on lower Carney Creek
CCS-1	Spring from base of west waste rock pile
CCS-6	Spring below west waste rock pile
CCS-8	Spring below west waste rock pile
CCS-9	Spring discharging to lower Carney Creek
CCS-11	Spring below central waste rock pile
CCS-14	Spring between central and east waste rock piles
CCS-16	Spring below east waste rock pile

* Sample will be collected if there is overflow from the impoundment during scheduled monitoring activities

Table 5-3
Phase IIA - Rainy Creek Watershed Surface Water Monitoring Summary

Station ID	Element 1	Element 2	Element 3	Element 4	Element 5
URC-1	X				
URC-1A	X	X			
URC-2	X	X‡			
LRC-1	X	X			
LRC-2	X	X	X	X	
LRC-3	X				
LRC-4	X				
LRC-5	X				
LRC-6	X	X	X	X	
FC-1	X				
FC-2	X	X			
FC-Pond	X	X‡†			
TP	X	X‡			
UTP	X*				TBD
TP-TOE1	X	X			
TP-TOE2	X				
TP-Overflow	X**	X**			
MP	X	X‡			
CC-1	X				
CC-2	X	X		X (spring)	
CC-Pond	X	X			
CCS-1	X				
CCS-6	X				
CCS-8	X				
CCS-9	X				
CCS-11	X				
CCS-14	X				
CCS-16	X				

‡ Rapid turn-around time for analysis of asbestos required to support selection of surface water toxicity test location

† Sample collection will be suspended after selection of the surface water toxicity test location

* Samples will be collected at two depths

** Sample will be collected if there is overflow from the impoundment during scheduled monitoring activities

TBD = To Be Determined; based on results of rapid turn-around samples

Table 5-4. Sample Containers, Preservation and Handling Requirements, and Holding Times for Sediment Samples

Container Description	Analyses	Method	Preservation and Handling	Extraction/Analysis Holding Times
8-oz glass jar	TAL Metals + Boron	EPA 6010/6020	Cool 4°C	180 days
	Mercury	EPA 7471A	Cool 4°C	28 days
	Total organic carbon (TOC)	LECO	Cool 4°C protect from sunlight and atmospheric oxygen	28 days
	Paste pH	EPA 9045D/ ASAM10-3.2	Cool 4°C	14 days
	Fluoride and total phosphorus	EPA 300.0/ SM4500-F-C EPA 365.1	Cool 4°C	14 days (F) 28 days (P)
	Cyanide	EPA 9012	Cool 4°C	14 days
40-mL glass vial with Teflon-lined crew cap (pre-preserved with methanol)	Volatile Petroleum Hydrocarbons	MADEP-VPH-04-1.1	Cool 4°C	28 days
4-oz wide-mouth amber glass jar with Teflon-lined screw cap	Extractable Petroleum Hydrocarbons	MADEP-EPH-04-1	Cool 4°C	14 days
4-oz glass jar	Organophosphate Pesticides	EPA 8141	Cool 4°C	14 days/40 days
8-oz glass jar	Chlorinated Pesticides	EPA 8081	Cool 4°C	14 days/40 days
	Herbicides	EPA 8151	Cool 4°C	14 days/40 days
	Polychlorinated Biphenyls (PCBs)	EPA 8082	Cool 4°C	14 days/40 days
40-mL glass vial with Teflon-lined crew cap (pre-preserved with methanol)	Volatile Organic Compounds (VOCs) (a)	EPA 8260B	Cool 4°C	14 days
4-oz amber glass jar with Teflon-lined screw cap	Semi-volatile Organic Compounds (SVOCs) (a)	EPA 8270C	Cool 4°C	14 days/40 days
500 g in Ziploc bag (soil) or plastic jar (sediment)	Asbestos	PLM-Grav: SRC-LIBBY-01 (Rev. 2) PLM-VE: SRC-LIBBY-03 (Rev. 2)	None	None
8-oz glass jar	*[Archive sample]*		Cool 4°C	–

(a) CLP analyte list

(b) with Libby-specific modifications

Table 5-5. Sample Containers, Preservation and Handling Requirements, and Holding Times for Aqueous Sample Matrices

Container Description	Analyses	Method	Preservation and Handling	Extraction/ Analysis Holding Times
250-mL plastic (pre-preserved with HNO_3)	TAL Metals+Boron (Total)	6010B/6020 and EPA 200 series methods (a)	Cool 4°C; HNO_3, pH<2	180 days
	Mercury	7470A/ EPA 245.1	Cool 4°C	28 days
250-mL plastic filtration container	TAL Metals+Boron (Dissolved), Hardness	6010B/6020 and EPA 200 series methods (a)	Cool 4°C; HNO_3 (preserve sample in field after filtering)	180 days
1-L amber glass	Dissolved Organic Carbon (DOC)	A5310C	Cool 4°C; H_3PO_4 (preserve sample in field after filtering)	28 days
500-mL plastic (pre-preserved with H_2SO_4)	Nitrate, Ammonia, Total Kjeldahl Nitrogen (TKN)	EPA 353.2, 350.1/350.2, 351.2	Cool 4°C; H_2SO_4, pH<2	28 days
	Orthophosphate	EPA 365.1	Cool 4°C; H_2SO_4, pH<2	28 days
3 x 40-mL amber glass vial with Teflon-lined screw cap (pre-preserved with HCl)	Volatile Petroleum Hydrocarbons (VPH)	MA-DEP VPH modified	HCl to pH <2 Cool 4°C	14 days
2 x 1-L amber glass bottle with Teflon-lined screw cap (pre-preserved with H_2SO_4)	Extractable Petroleum Hydrocarbons (EPH)	MA-DEP EPH modified	H_2SO_4 to pH <2, Cool 4°C	14 days/40 days
1-L plastic	Fluoride/Chloride/Sulfate	EPA 300.0	Cool 4°C	28 days
	Total Suspended Solids (TSS)	Standard Methods 2540D	Cool 4°C	7 days
	Nitrite	EPA 353.2	Cool 4°C	48 hours
	Total Dissolved Solids (TDS)	Standard Methods 2540C	Cool 4°C	7 days
	Alkalinity	Standard Methods 2320B	Cool 4°C	14 days
2 x 1-L amber glass	Organophosphate Pesticides	EPA 8141	Cool 4°C	7 days/40 days
2 x 1-L amber glass	Chlorinated Pesticides	EPA 8081	Cool 4°C	7 days/40 days
	Polychlorinated Biphenyls (PCBs)	EPA 8082	Cool 4°C	7 days/40 days
2 x 1-L amber glass	Herbicides	EPA 8151	Cool 4°C	7 days/40 days
2 x 1-L amber glass (b)	Semi-volatile Organic Compounds (SVOCs) (c)	EPA 8270C	Cool 4°C	7 days/40 days
3 x 40 mL vials; no headspace (pre-preserved with HCl)	Volatile Organic Compounds (VOCs) (c)	EPA 8260B	Cool 4°C; HCl pH<2	14 days
1-L plastic (pre-preserved with HNO_3)	Radiochemistry (gross alpha and gross beta)	EPA 900.0	Cool 4°C; HNO_3	None
	Radium, Uranium	EPA 900.3, EPA 200 series	Cool 4°C; HNO_3	180 days
500-mL plastic(pre-preserved with NaOH)	Cyanide	Kelada mod.	Cool 4°C; NaOH, pH>12	14 days
1 L HDPE container	Asbestos	ISO 10312 (d)	Cool 4°C	Filtered within 48 hours

(a) 200 series methods: 200.7, 200.8

(b) 2 additional 1-L amber glass containers will be needed for MS/MSD

(c) CLP analyte list

(d) with Libby-specific modifications

Table 6-1. List of Non-Asbestos Analyses Required for Surface Water for Element 1 (Spring, Summer)

		Cations			Pesticides			PCBs	VOCs	SVOCs	PAHs	Petroleum Hydrocarbons			Nitrogen Compounds				Radionuclides				Anions			Water quality parameters		
		TAL Metals		Hg								Extractable HC		Volatile HC	NH4	Total N	N02+N03	NO2	Gross α	Ra226	Ra228	Ra226+228	Cl, F, SO4	PO4	CN	HCO3,CO3	TDS	DOC
Reach	Station	SW6020	SW6010B	SW7470A	SW8081A	SW8151A	8141A	SW8082	SW8260B	SW8270C	SW8270C	MA-EPH	SW8015M	MA-VPH	E350 1	E351 2	E353 2	EJ53 2	E900 0	E903 0	RA-05	A7500-RA	E300 0	E365 1	Kelada	A2320 B	A2540C,D	A5310 C
Upper Rainy Creek	URC-1	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	URC-1A	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	URC-2	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Tailings impoundment	TP	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	UTP	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	TP-TOE1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	TP-TOE2	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	TP-Overflow	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Mill pond	MP	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Lower Rainy Creek	LRC-1	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	LRC-2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	LRC-3	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	LRC-4	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	LRC-5	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	LRC-6	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Fleetwood Creek	FC-1	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	FC-Pond	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	FC-2	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Carney Creek	CC-1	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CC-Pond	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CC-2	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
Seeps	CCS-1	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-6	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-8	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-9	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-11	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-14	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X
	CCS-16	X	X	X								X	X	X	X	X	X	X					X	X		X	X	X

x = Sample analyzed

Table 6-2. List of Non-Asbestos Analyses Required for Sediment in Element 1 (Spring and Summer)

		Cations			Pesticides			PCBs	VOCs	SVOCs	PAHs	Pertroleum Hydrocarbons			Anions		Sediment quality parameters		
		TAL Metals		Hg								Extractable HC		Volatile HC	Fluoride	Phosphorus	pH	Moisture	OC
Reach	Station	SW6020	SW6010B	SW7470A	SW8081A	SW8151A	8141A	SW8082	SW8260B	SW8270C	SW8270C	MA-EPH	SW8015M	MA-VPH	E300.0	E365.1	ASAM10-3.2	SW3550A	Leco
Upper Rainy Creek	URC-1	X	X	X								X	X	X	X	X	X	X	X
	URC-1A	X	X	X								X	X	X	X	X	X	X	X
	URC-2	X	X	X								X	X	X	X	X	X	X	X
Tailings impoundment	TP	X	X	X								X	X	X	X	X	X	X	X
	UTP	X	X	X								X	X	X	X	X	X	X	X
	TP-TOE1	X	X	X								X	X	X	X	X	X	X	X
	TP-TOE2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mill pond	MP	X	X	X								X	X	X	X	X	X	X	X
Lower Rainy Creek	LRC-1	X	X	X				X				X	X	X	X	X	X	X	X
	LRC-2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	LRC-3	X	X	X				X				X	X	X	X	X	X	X	X
	LRC-4	X	X	X				X				X	X	X	X	X	X	X	X
	LRC-5	X	X	X				X				X	X	X	X	X	X	X	X
	LRC-6	X	X	X				X				X	X	X	X	X	X	X	X
Fleetwood Creek	FC-1	X	X	X								X	X	X	X	X	X	X	X
	FC-Pond	X	X	X								X	X	X	X	X	X	X	X
	FC-2	X	X	X								X	X	X	X	X	X	X	X
Carney Creek	CC-1	X	X	X								X	X	X	X	X	X	X	X
	CC-Pond	X	X	X								X	X	X	X	X	X	X	X
	CC-2	X	X	X								X	X	X	X	X	X	X	X
Seeps	CCS-1	X	X	X								X	X	X	X	X	X	X	X
	CCS-6	X	X	X								X	X	X	X	X	X	X	X
	CCS-8	X	X	X								X	X	X	X	X	X	X	X
	CCS-9	X	X	X								X	X	X	X	X	X	X	X
	CCS-11	X	X	X								X	X	X	X	X	X	X	X
	CCS-14	X	X	X								X	X	X	X	X	X	X	X
	CCS-16	X	X	X								X	X	X	X	X	X	X	X

x = Sample analyzed

TABLE 7-1
STATIC RENEWAL CYCLE AND WATER SAMPLE NAMING SYSTEM

Day	Cycle	Sample Name	
		Dilution 1	Dilution 2 (etc.)
1	1	Dilution 1 Cycle 1 New	Dilution 2 Cycle 1 New
2			
3			
4			
5			
6			
7			
8			
9			
10		Dilution 1 Cycle 1 Old	Dilution 2 Cycle 1 Old
11	2	Dilution 1 Cycle 2 New	Dilution 2 Cycle 2 New
12			
13			
14			
15			
16			
17			
18			
19			
20		Dilution 1 Cycle 2 Old	Dilution 2 Cycle 2 Old
21	3	Dilution 1 Cycle 3 New	Dilution 2 Cycle 3 New
22			
23		Dilution 1 Cycle 3 Old	Dilution 2 Cycle 3 Old
24	4	Dilution 1 Cycle 4 New	Dilution 2 Cycle 4 New
25			
26		Dilution 1 Cycle 4 Old	Dilution 2 Cycle 4 Old
27	5	Dilution 1 Cycle 5 New	Dilution 2 Cycle 5 New
28			
29		Dilution 1 Cycle 5 Old	Dilution 2 Cycle 5 Old
30	6	Dilution 1 Cycle 6 New	Dilution 2 Cycle 6 New
31			
32		Dilution 1 Cycle 6 Old	Dilution 2 Cycle 6 Old
33	7	Dilution 1 Cycle 7 New	Dilution 2 Cycle 7 New
34			
35		Dilution 1 Cycle 7 Old	Dilution 2 Cycle 7 Old
36	8	Dilution 1 Cycle 8 New	Dilution 2 Cycle 8 New
37			
38		Dilution 1 Cycle 8 Old	Dilution 2 Cycle 8 Old
39	9	Dilution 1 Cycle 9 New	Dilution 2 Cycle 9 New
40			
41		Dilution 1 Cycle 9 Old	Dilution 2 Cycle 9 Old
42	Sacrifice remaining fish		

TABLE 7-2. BEHAVIORAL LOG

Water Sample = _____ Study Start Date = _____

Day	Observations
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
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32	
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35	
36	
37	
38	
39	
40	
41	
42	

TABLE 7-3. MORTALITY AND GROWTH LOG

Test water description = Mill Pond
Test water code = MP

Aquarium	Fish	Label Assigned	Day of death	Time death was noted	Length (mm)	Weight (mg)	Notes
A	1	MP-A1					
	2	MP-A2					
	3	MP-A3					
	4	MP-A4					
	5	MP-A5					
	6	MP-A6					
	7	MP-A7					
	8	MP-A8					
	9	MP-A9					
	10	MP-A10					
	11	MP-A11					
	12	MP-A12					
	13	MP-A13					
	14	MP-A14					
	15	MP-A15					
B	1	MP-B1					
	2	MP-B2					
	3	MP-B3					
	4	MP-B4					
	5	MP-B5					
	6	MP-B6					
	7	MP-B7					
	8	MP-B8					
	9	MP-B9					
	10	MP-B10					
	11	MP-B11					
	12	MP-B12					
	13	MP-B13					
	14	MP-B14					
	15	MP-B15					
C	1	MP-C1					
	2	MP-C2					
	3	MP-C3					
	4	MP-C4					
	5	MP-C5					
	6	MP-C6					
	7	MP-C7					
	8	MP-C8					
	9	MP-C9					
	10	MP-C10					
	11	MP-C11					
	12	MP-C12					
	13	MP-C13					
	14	MP-C14					
	15	MP-C15					

Table 8-1. Field Quality Control Samples

Field QC Sample Type	Applicable Sample Media	Minimum Collection Frequency	Analyses to be Performed	Acceptance Criteria	Corrective Action
Field Blank	Water	1 per 10 field samples (10%)	TEM	No LA structures detected	Assign qualifier to analyte(s) in field samples associated with field blank (same day, same team)
			Metals, Anions, VPH, EPH, DOC	< ½ PQL for all target analytes	
Trip Blank	Water	1 per cooler of samples for VOC and VPH analyses	SW 8260 or MA-DEP-VPH (a)	< ½ PQL for all target analytes	Assign qualifier to analyte(s) in field samples associated with trip blank (same cooler)
	Solid Media		SW 8260 or MA-DEP-VPH (a)	< ½ PQL for all target analytes	
Equipment Rinsate Blank	Water	1 per sampling team per day	TEM	No LA structures detected	Assign qualifier to analyte(s) in field samples associated with field blank (same day, same team)
			Metals, Anions, VPH, EPH, DOC (SW only)	< ½ PQL for all target analytes	
	Solid Media		TEM	No LA structures detected	
			Metals, Fluoride, Phosphorus, VPH, EPH, PCBs	< ½ PQL for all target analytes	
Field Duplicate	Water	1 per 10 field samples (10%)	TEM	< 5% statistically different (b)	Assign qualifier to analyte(s) in parent field sample to note when advisory limits are exceeded
			Same analyte list as original sample	25% RPD for target analytes (b)	
	Sediment	1 per 10 field samples (10%)	PLM-VE	*[Not applicable for field duplicates]*	
			Same analyte list as original sample	50% RPD for target analytes (b)	
Performance Evaluation (PE)	Water	4 PE samples	Inorganic and organic analytes	(c)	Assign qualifier to field samples for analyte(s) outside of acceptance criteria
	Solid Media	4 PE samples	PLM-VE	80% concordance	
		3 PE samples	Inorganic and organic analytes	(c)	

(a) depending on analyses requested with associated samples
(b) no quantitative requirement for agreement specified for this project; value shown is an advisory limit
(c) meet analyte-specific criteria specified by QATS certification program

Table 8-2
Phase IIA Field Quality Control Samples by Element

Panel A: Surface Water

Sample Type	QC Frequency Requirement	Number Specified	Notes
Element 1 - Seasonal Monitoring			
Field Sample	--	*58*	*[a]*
Field Duplicate	1 per 10 field samples (10%)	6	[b]
Field Blank	1 per 10 field samples (10%)	6	[b]
Trip Blank	1 per cooler of samples for VOC analysis	n/a	[c]
Performance evaluation	4 samples with a range of inorganic and organic analyte concentrations	4	
Element 2 - Spring Runoff Monitoring			
Field Sample	--	*127*	*[d]*
Field Duplicate	1 per 10 field samples (10%)	13	[e]
Field Blank	1 per 10 field samples (10%)	13	[e]
Element 3 - Summer-Fall Monitoring			
Field Sample	--	*20*	*[f]*
Field Duplicate	1 per 10 field samples (10%)	2	[g]
Field Blank	1 per 10 field samples (10%)	2	[g]
Element 5 - Water Collection for Toxicity Testing			
Field Sample	--	*135 (37)*	*[h]*
No Field QC Samples to be Collected During Toxicity Test			
Kootenai River Sampling			
Field Sample	--	*18*	*[i]*
Field Duplicate	1 per 10 field samples (10%)	2	[j]
Field Blank	1 per 10 field samples (10%)	2	[j]

Panel B: Sediment

Sample Type	QC Frequency Requirement	Number Specified	Notes
Element 1 - Seasonal Monitoring			
Field Sample	--	110	[k]
Field Duplicate	1 per 10 field samples (10%)	11	[b]
Trip Blank	1 per cooler of samples for VOC/PH analysis	n/a	[c]
Performance evaluation	4 samples across varying LA mass fractions	4	
	3 samples with a range of inorganic and organic analyte concentrations	3	
Kootenai River Sampling			
Field Sample	--	12	[l]
Field Duplicate	1 per 10 field samples (10%)	2	

[a] Two sampling events -- spring and summer (29 field samples per event)
[b] Collect half of specified number during spring event and other half in summer event
[c] Number of coolers needed may vary based on field collection staging and packaging.
[d] Assumes 10 weekly monitoring events (7 events at 13 stations; 3 events at 12 stations)
[e] Collect required field QC samples evenly across weeks (i.e., approx. 1 field duplicate and 1 field blank per week)
[f] Assumes 7 weekly monitoring events at two stations plus 6 samples during storm event
[g] Collect one field QC "set" (1 duplicate, 1 blank) during weekly sampling and other field QC set during storm sampling
[h] Number in parentheses indicates the subset that will be submitted for analysis (Cycle 1 and Cycle 7).
Total Samples = 6 mixing test samples (3 top, 3 bottom) + 3 pre-samples +
126 toxicity test samples (7 dilutions x 9 cycles x 2 samples per cycle)
[i] Two sampling events -- high flow and low flow (9 field samples per event)
[j] Collect one field QC "set" (1 duplicate, 1 blank) during high flow sampling and other field QC set during low flow sampling
[k] Two sampling events -- spring and summer (55 field samples per event)
[l] Assumes 4 grab samples from depositional areas and 2 borings x 4 depth strata per boring.

Table 8-3
Phase IIA Laboratory Quality Control Samples for Asbestos Analyses

Panel A: TEM Analyses of Surface Water

Sample Type	QC Frequency Requirement	Number Specified	Notes
Field Samples	--	*260*	
Analytical Laboratory QC Samples			
Laboratory Blank	4% (OU3 project and medium-specific)	10	[a]
Recount Same	1% (OU3 project and medium-specific)	3	
Recount Different	2.5% (OU3 project and medium-specific)	7	
Verified Analysis	1% (OU3 project and medium-specific)	3	
Repreparation	1% (OU3 project and medium-specific)	3	
Interlab	0.5% (OU3 project and medium-specific)	1	[b]

Panel B: PLM Analyses of Sediment

Sample Type	QC Frequency Requirement	Number Specified	Notes
Field Samples	--	122	
Preparation Laboratory QC Samples			
Preparation Blank	1 per batch	6	[c]
Preparation Split	1 per 20 field samples (5%)	7	
Analytical Laboratory QC Samples			
Laboratory Duplicate	1 per 10 field samples (10%)	13	

[a] Approx. one per analytical laboratory job
[b] To be selected post analysis by EPA
[c] Assumes 6 batches of approx. 20 samples per batch

Table 8-4. Non-Asbestos Laboratory Quality Control Measures by Analytical Method

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
ICP Metals SW-846 6010B (and EPA 200.7 for aqueous samples)	Initial calibration (1 point + blank minimum)	Daily prior to analysis	Correlation coefficient (r) ≥0.995	• Recalibrate
	Interference check standard (ICS)	Beginning and end of each analytical run	Results +/- 20% of true value	• Terminate analysis • Recalibrate instrument • Reanalyze all samples back to last acceptable ICS
	Initial calibration verification (ICV)	After calibration, prior to sample analysis	Results <10% from calibration standard	• Reanalyze ICV • Recalibrate, if ICV still out
	Continuing calibration verification (CCV)	Every 10 samples and end of analytical sequence	Results < 10% from calibration standard	• Reanalyze affected samples back to the last acceptable CCV
	Calibration blank - Initial calibration blank (ICB), Continuing calibration blank (CCB)	After initial calibration verification, each subsequent calibration verification, and at the end of the run	<3x the Method detection limit (MDL)	• Reanalyze blank • Clean system • Reanalyze all samples back to last acceptable blank
	Method blank	1 per preparation batch (≤20 samples)	< ½ x Practical quantitation limit (PQL)	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery +/-25% of actual value	• Assess data (4 x rule) • If LCS recoveries are within acceptance criteria, then matrix interference may be suspected • Reanalyze reprep once if matrix is not a factor • Narrate all outliers
	Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	RPD <20%	• Same as MS
	Laboratory Control Sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery +/- 20% of actual value	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers
ICP-MS Metals SW-846 6020 (and EPA 200.8 for aqueous samples)	Mass calibration and resolution check (4 replicates)	Daily prior to analysis	Mass calibration < 0.1 amu; resolution <0.9 amu at 10% peak height; RSD <5%	• Recalibrate
	Initial multipoint calibration (1 point + blank minimum); average of 3 integrations	Daily prior to analysis	None	• None
	Initial calibration verification (ICV); mid-level standard second source	After calibration, prior to sample analysis	± 10% from true value	• Reanalyze ICV • Recalibrate, if ICV still out
	Continuing calibration verification (CCV)	Every 10 samples and end of run sequence	± 10% from true value	• Reanalyze affected samples back to the last acceptable CCV

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
ICP-MS Metals SW-846 6020 (and EPA 200.8 for aqueous samples)	Interference check solution	At beginning of analytical sequence or once every 12 hours, whichever is more frequent	Recoveries +/- 20% of theoretical value	• Internal QC review only; flag data to indicate interference
	Internal Standards	Every CCV, ICB/CCB	Recoveries +/- 20% of initial calibration	• Recalibrate and verify calibration • Reanalyze affected samples
		Every sample	Recoveries 30-120% for samples	• Dilute sample 5x and reanalyze • Repeat until within limits
	Calibration blank Initial calibration blank (ICB) Continuing calibration blank (CCB)	After initial calibration and each subsequent calibration verification	< 3 x Method detection limit (MDL)	• Reanalyze blank • Clean system if still out • Reanalyze affected samples back to the last acceptable CCB
	Method blank	1 per preparation batch (≤ 20 samples)	< ½ x PQL	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
	Matrix spike (MS)	1 per preparation batch (≤ 20 samples)	% Recovery +/- 25% of true value	• Assess data • Reanalyze MS if matrix is not a factor
	Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤ 20 samples)	RPD < 20% (for values > 100 x MDL)	• Same as MS
	Post-digestion spike addition	As necessary to assess matrix interference	% Recovery +/- 25% of actual value	• Perform dilution test • Or, perform method of standard addition
	Dilution test	1 per 20 samples	% Recovery +/- 10% of true value	• Use method of standards addition
	Laboratory control sample (LCS)	1 per preparation batch (≤ 0 samples)	%Recovery within +/- 20% of true value	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers
Mercury SW-846 7470A/7471A	Initial multipoint calibration (3 point + blank minimum)	Daily, prior to analysis	Correlation coefficient (r) ≤0.995	• Recalibrate
	Initial calibration verification (ICV); mid-level standard	After calibration, prior to sample analysis	± 20% of true value	• Reanalyze ICV • Rerun initial calibration
	Continuing calibration verification (CCV); mid-level standard	Every 10 samples and at end of analytical sequence	± 20% of true value	• Reanalyze affected samples back to last acceptable CCV
	Calibration blank (ICB/CCB)	After calibration, and after each subsequent calibration verification	< ½ x PQL	• Reanalyze blank • Clean system if still out • Reanalyze affected samples back to last acceptable CCB
	Method blank	1 per preparation batch (≤20 samples)	< ½ x PQL	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
Mercury SW-846 7470A/7471A	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery +/- 25% of true value	• If LCS recoveries are within acceptance criteria, matrix interference may be suspected • Reprep/reanalyze once if problem cannot be attributed to matrix • Narrate all outliers
	Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	RPD < 20%	• Same as MS
	Laboratory control samples (LCS)	1 per preparation batch (≤20 samples)	%Recovery within +/- 20% of true value	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers
SW-846, 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Tune instrument with a 4-bromofluorobenzene standard (BFB)	Every 12 hours	Must meet key ions and ion abundance criteria established by method.	
	Initial multi-point calibration; 5 point minimum. Lowest point at or below PQL. Includes calibration check compounds (CCC) and system performance check compounds (SPCC), and Internal Standards Compounds (IS).	Prior to analysis, and as required	RSD< 30 % for CCC; Average RF ≥ 0.1 for SPCC (≥0.3 for chlorobenzene, 1,1,2,2-Tetrachloroethane) If % RSD < 15% average RF may be used; linear calibration required	• Evaluate system • Repeat calibration
	Continuing calibration verification (CCV): CCC, SPCC, and IS	Every 12 hours	Percent difference <20% for CCC; RF ≥0.1 for SPCC (≥0.3 for chlorobenzene and 1,1,2,2-Tetrachloroethane).	• Evaluate system/standard • Reanalyze calibration check standard • Repeat initial calibration •
	IS	Every sample, method blank, LCS, MS/MSD	Retention time for each internal standard must be within 30 seconds of most recent CCV and the EICP area for all internal standards must be within -50% to +100% of the most recent CCV.	• Evaluate system • Reanalyze sample once • Re-extract/reanalyze sample once • If due to media interference report both sets of data • Narrate all outliers
	Method blank	1 per preparation batch (≤20 samples)	< ½ x PQL	• Reanalyze method blank • Reanalyze batch
	Internal standards	Every sample, method blank, LCS, and MS/MSD	Retention time for each internal standard must be within 30 seconds of most recent CCV and the EICP area for all internal standards must be within -50% to +100% of the most recent CCV	• Evaluate system/standard • Reanalyze samples • If still out, report both sets of data • Narrate all outliers

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846, 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Surrogate spike	Every sample, method blank, LCS, MS/MSD	No more than one surrogate outside QC acceptance criteria. No surrogate below 10% recovery.	• Reanalyze sample once • Re-extract and reanalyze if >1 surrogate outside QC acceptance limits • If still out, report both sets of data • Narrate all outliers
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	Percent recovery within QC acceptance criteria	• Assess data (4x rule) • If LCS and surrogate recoveries are within acceptance criteria matrix interferences may be suspected • Reprep/reanalyze once if matrix is not a factor • Narrate all outliers
	Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria	• Same as MS
	Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Reanalyze LCS • Reprep/reanalyze LCS and all associated samples • Narrate all outliers
SW-846 8270C Semi-Volatiles by GC/MS	Tune the instrument using a decafluorotriphenylphosine (DFTPP) standard	Every 12 hours	Must meet the ion abundance criteria specified in the Degradation of DDT ≤ 20% Benzidine and PCP present at normal response without excessive tailing	• Retune instrument • Repeat standard analysis • Perform injection port, column maintenance as necessary
	Initial calibration (5 point minimum); includes Calibration Check Compounds (CCC), System Performance Calibration Check (SPCC), and Internal Standard Compounds (IS)	Prior to analysis and as required	% RSD for CCC ≤30%; average RF ≥0.05 for SPCC If % RSD ≤15 % average RF may be used; linear calibration required	• Evaluate the system • Repeat calibration
	Continuing calibration verification (CCV); includes CCC, SPCC, and IS	Every 12 hours	CCV percent difference for CCC ≤30%; RF ≥0.05 for SPCC EICP area of each internal standard - 50% to +100% of all IS areas in most recent CCV. Retention time for each internal standard must be within 30 seconds of most recent CCV	• Evaluate system/standard • Reanalyze calibration check standard • Repeat the initial calibration as necessary
	Method blank	1 per preparation batch (≤20 samples)	< ½ x PQL	• Reanalyze blank • Reprep/reanalyze blank and all associated samples

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C Semi-Volatiles by GC/MS	Internal Standard	Every sample, method blank, LCS and MS/MSD	The EICP area for all internal standards must be within -50% and +100% of most recent CCV Retention time for each internal standard must be within 30 seconds of most recent CCV	• Evaluate system/standard • Reanalyze the sample • If still out, report both sets of data
	Surrogate spike	Every sample, method blank, LCS and MS/MSD	No more than one surrogate per fraction outside of acceptance criteria (Refer to Table B1-a) No surrogate below 10% recovery	• Reanalyze sample once • Re-extract and reanalyze if >1 surrogate per fraction outside acceptance limits • Narrate all outliers
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Assess data (4x rule) • Reanalyze once; if matrix is not a factor • If LCS and surrogate recoveries are within acceptance criteria matrix interference maybe suspected • Narrate all outliers
	Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria	• Same as MS
	Laboratory control sample	1 per preparation batch (≤20 samples)	% Recovery within project QC acceptance criteria for all spiked analytes	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers
SW-846 8082 Polychlorinated biphenyls (PCBs) by Gas Chromatography	Initial calibration (5 point minimum) Lowest standard at or below PQL; Expected Aroclors or Aroclor 1016/1260 five-point if unknown with single-point mid-level standards for other Aroclors for pattern recognition and retention times, or	Prior to analysis and as required	RSD <20%, average calibration factor or response factor(a) may be used; linear calibration required	• Evaluate the system • Repeat initial calibration
	Initial calibration verification (ICV) Mid level standard Expected Aroclors or Aroclor 1016/1260 if unknown	Prior to each 12 hour shift	% Difference ≤15% of expected concentration compared to response from ICAL	• Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
	Continuing calibration verification (CCV) Mid level standard Expected Aroclors or Aroclor 1016/1260 if unknown	After every 20 samples and at the end of the analytical sequence	% Difference ≤15% of expected concentration compared to response from ICAL for each bracketing standard	• Evaluate system/standard • Reanalyze CCV and samples back to last acceptable CCV
	Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	Retention times must be within retention time window established by the daily initial calibration standard Every CCV and every sample	• Evaluate system/standard; pattern recognition may be sufficient • Reanalyze CCV/affected samples

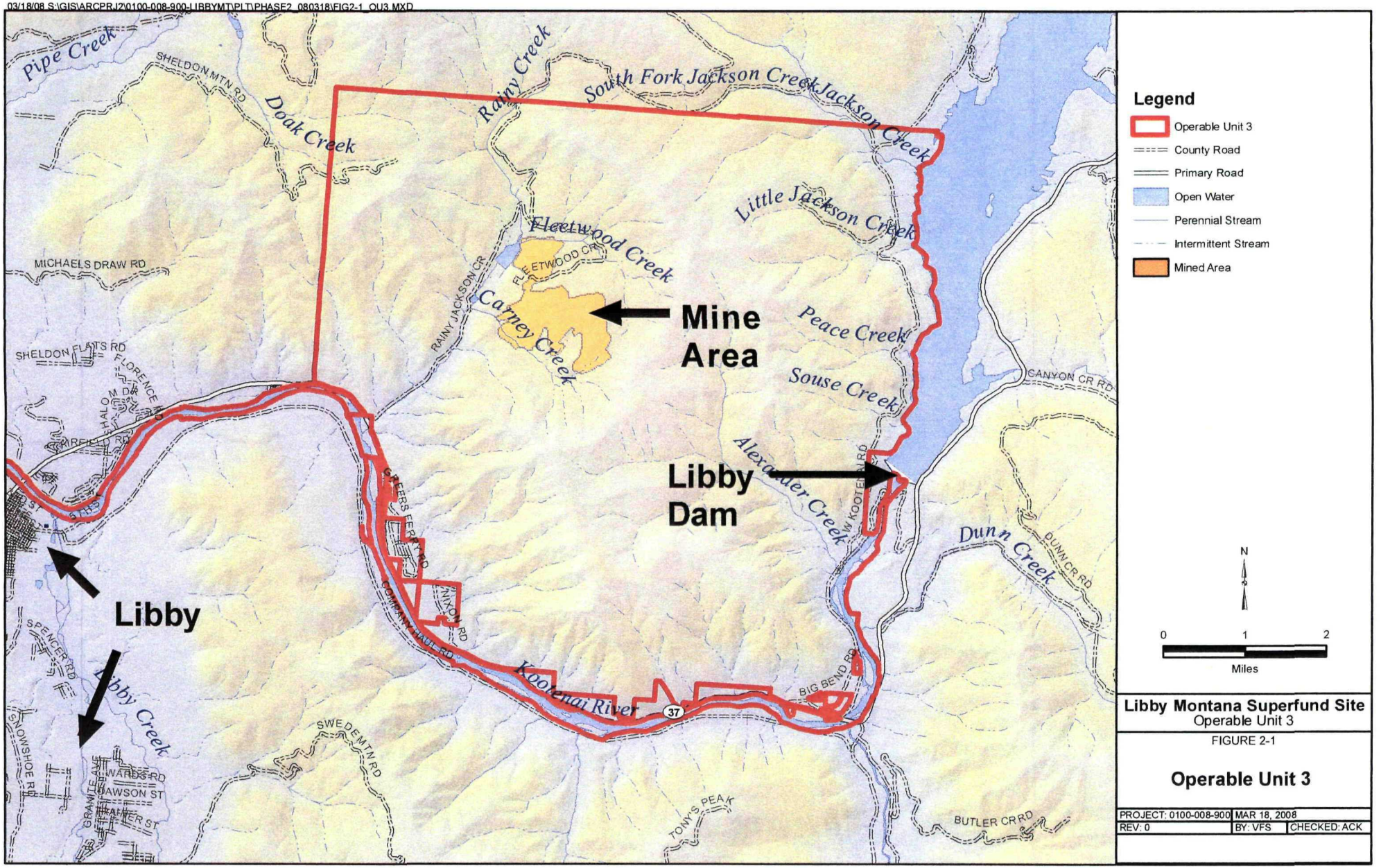
Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8082 Polychlorinated biphenyls (PCBs) by Gas Chromatography	Method Blank	1 per preparation batch (≤20 samples)	< ½ x PQL	• Reanalyze blank • Re-prep/reanalyze blank and associated samples
	Surrogate spike DCB (for Aroclors) TCMX (for PCB congeners)	Every sample, method blank, LCS and MS/MSD	% Recovery within QC acceptance criteria	• Re-extract/reanalyze once • If still out, report both sets of data Narrate all outliers
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Assess data (4x rule) • If LCS and surrogate recoveries are within acceptance criteria matrix interference maybe suspected • Re-extract/reanalyze if matrix is not a factor • Narrate all outliers
	Matrix spike duplicate(MSD) or Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria	• Same as MS
	Laboratory control sample(LCS)	1 per preparation batch (≤20 samples)	% Recovery within project QC acceptance criteria	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers
SW-846 8081A Organochlorine Pesticides by Gas Chromatography	Column Evaluation Mix	Prior to analysis, both initial and daily	Degradation of DDT and Endrin < 15%	• Evaluate the system • Repeat standard
	Initial calibration (5 point minimum) Lowest at or below PQL Mid level multi-component standards for pattern recognition and retention times	Prior to analysis and as required	RSD < 20%, average CF may be used; linear calibration required	• Average RSD <20% across all analytes may be used if any analyte fails • Evaluate the system • Repeat initial calibration
	Initial calibration verification (ICV) Mid level standard Expected multi-component compounds	Prior to each 12 hour shift	% Difference ≤15% of expected concentration compared to response from ICAL	• Average % difference ≤15% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
	Continuing calibration verification (CCV) Mid level standard Expected multi-component compounds	After every 20 samples and at the end of the analytical sequence	% Difference ≤15% of expected concentration compared to response from ICAL for each bracketing standard	• Average % difference ≤15% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze CCV and affected samples • For CCV with response > initial calibration response and % difference >15%, samples need not be reanalyzed if no target compounds are detected

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081 Organochlorine Pesticides by Gas Chromatography	Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	Retention times must be within retention time window established by the daily initial calibration standard Every CCV and every sample	• Evaluate system/standard; pattern recognition may be sufficient for multi-component compounds only • Reanalyze CCV/affected samples
	Method Blank	1 per preparation batch (≤ 20 samples)	< ½ x PQL	• Reanalyze blank • Re-prep/reanalyze blank and associated samples
	Surrogate spike DCB and TCMX	Every sample, method blank, LCS and MS/MSD	% Recovery within QC acceptance criteria. One surrogate must fall within established control limits	• Re-extract/reanalyze once • If still out, report both sets of data • Narrate all outliers
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Assess data (4 x rule) • If LCS and surrogate recoveries are within acceptance criteria, matrix interference maybe suspected • Re-extract/reanalyze once if matrix is not a factor • Narrate all outliers
	Matrix spike duplicate(MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria.	• Same as MS
	Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	% Recovery within QC acceptance criteria	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers
SW-846 8141A Organphosphorus Pesticides by Gas Chromatography	Initial calibration (5 point minimum) Lowest at or below ½ x PQL	Prior to analysis and as required	If %RSD < 20% average RF may be used If linear regression used r > 0.995 or R2 >0.990 Alternate evaluation: Mean % RSD for all target analytes <20% with no individual compound >40%	• Average RSD <20% across all analytes may be used if any analyte fails • Evaluate the system • Repeat initial calibration
	Initial calibration verification (ICV), second source Mid level standard	Prior to every analytical sequence	% Difference ≤15% of expected concentration compared to response from ICAL	• Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
	Continuing verification standard (CVS) Mid level standard	After every 10 samples and at the end of the analytical sequence	%D or % Drift >15%	• Evaluate system/standard • Repeat sample analysis to last acceptable CVS
	Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	Retention times must be within retention time window established by the daily initial calibration standard Every CVS and every sample	• Evaluate system/standard; pattern recognition may be sufficient for multi-component compounds only • Reanalyze CVS/affected samples
	Target analyte confirmation	All detected analytes	RPD < 40%	• If greater than 40% qualify data as estimated

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8141A Organphosphorus Pesticides by Gas	Method Blank	1 per preparation batch (≤ 20 samples)	< ½ x PQL	• Reanalyze blank • Reprep/reanalyze blank and associated samples
	Surrogate spike	Every sample, method blank, LCS and MS/MSD	% Recovery within QC acceptance criteria	• Reanalyze • Reprep/reanalyze once • If still out, report both sets of data • Narrate all outliers
	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Reanalyze • Reprep/reanalyze once • If still out, report both sets of data • Narrate all outliers
	Matrix spike duplicate(MSD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria	• Same as MS
	Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	% Recovery within QC acceptance criteria	• Reanalyze LCS • Reprep/reanalyze LCS and all associated samples • Narrate all outliers
SW-846 8151A Organochlorine Herbicides and Pentachlorophenol by Gas Chromatography	Initial calibration (5 point minimum) Lowest point at or below PQL	Prior to analysis and as required	%RSD <20%, average CF may be used; linear calibration required	• Average RSD <20% across all analytes may be used if any analytes fail • Evaluate the system • Repeat initial calibration
	Initial calibration verification (ICV) second source Mid level standard	Prior to each daily analytical sequence	% Difference ≤15% of expected concentration compared to response from ICAL	• Average %D ≤15% across all analytes may be used if any analytes fail • Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
	Continuing calibration verification (CCV) Mid level standard	After every 20 samples and at the end of the analytical sequence	% Difference ≤15% of expected concentration compared to response from ICAL for each bracketing standard	• Evaluate system/standard • Reanalyze CCV and all samples back to last acceptable CCV
	Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	Retention times must be within retention time window established by the daily initial calibration standard Every CCV and every sample	• Evaluate system/standard; • Reanalyze CCV and affected samples
	Method blank	1 per preparation batch (≤20 samples)	< ½ x PQL	• Reanalyze blank • Re-prep/reanalyze blank and all associated samples
	Surrogate spike DCAA	Every sample, method blank, LCS and MS/MSD	% Recovery within project QC acceptance criteria	• Re-extract/reanalyze once • If still out, report both sets of data • Narrate all outliers

Analytical Method[a]	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8151A Organochlorine Herbicides and Pentachlorophenol by Gas Chromatography	Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Assess data (4x rule) • If LCS and surrogate recoveries are within acceptance criteria, matrix interference maybe suspected • Re-exact/reanalyze once if matrix is not a factor • Narrate all outliers
	Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria	• Same as MS
	Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers
Total Cyanide SW-846 9012B	Initial calibration curve (six standards and a calibration blank)	Initial daily calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	• Correct problem then repeat initial calibration
	Distilled standards (one high and one low)	Once per initial calibration	Cyanide within ±10% of true value	• Correct problem then repeat distilled standards
	Second-source calibration verification	One per preparation batch (<20 samples)	Cyanide within ±15% of expected value	• Correct problem then repeat initial calibration
	Method blank	One per analytical batch	< ½ x PQL	• Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes	One per preparation batch (<20 samples)	QC acceptance criteria	• Correct problem then reanalyze the affected batch • If still out, reprep and reanalyze the LCS and all samples in the affected batch
	MS/MSD	One per preparation batch (<20 samples)	QC acceptance criteria	• None
Gross Alpha and Gross Beta SW-846-9310	Initial calibration with standard reference materials	Daily before sample analysis	Analytical method control limits	• Correct problem and repeat calibration
	Method Blank	One per analytical batch	< ½ x PQL	• Identify and reduce contamination then reanalyze
	Analytical Duplicate	One per analytical batch	RPD < 20	• Evaluated problem and correct the reanalyze
	Spiked Sample or standard reference material	One per analytical batch	80-120% recovery	• Evaluated problem and correct the reanalyze

EICP Extracted ion current profile
QC Quality control
RF Response factor
RSD Relative standard deviation



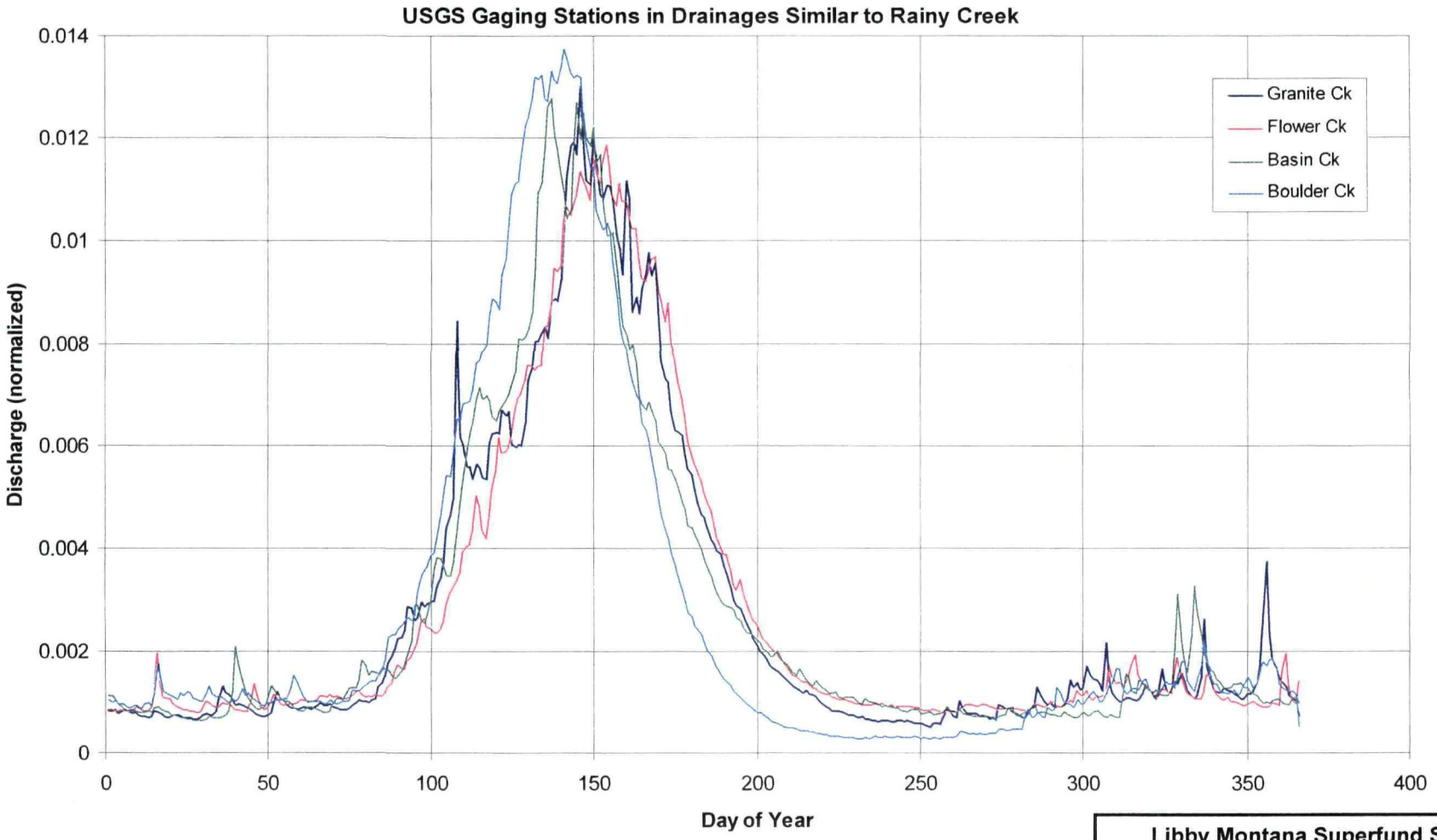
Libby Montana Superfund Site
Operable Unit 3

FIGURE 2-1

Operable Unit 3

PROJECT: 0100-008-900	MAR 18, 2008	
REV: 0	BY: VFS	CHECKED: ACK

S:\Jobs\0100-008-900-USEPA-LibbySFSOU3\Phase 2 Surface Water Sampling\Watersheds\CalDay.ppt



Notes:
Normalized discharge represents the average daily discharge divided by the average annual discharge.

12305500 – Boulder Creek (POR: 1928 – 1977)
12303100 – Flower Creek (POR: 1960 – 1992)
12302500 – Granite Creek (POR: 1933 – 1969)
12304040 – Basin Creek (POR: 1990 – 2000)

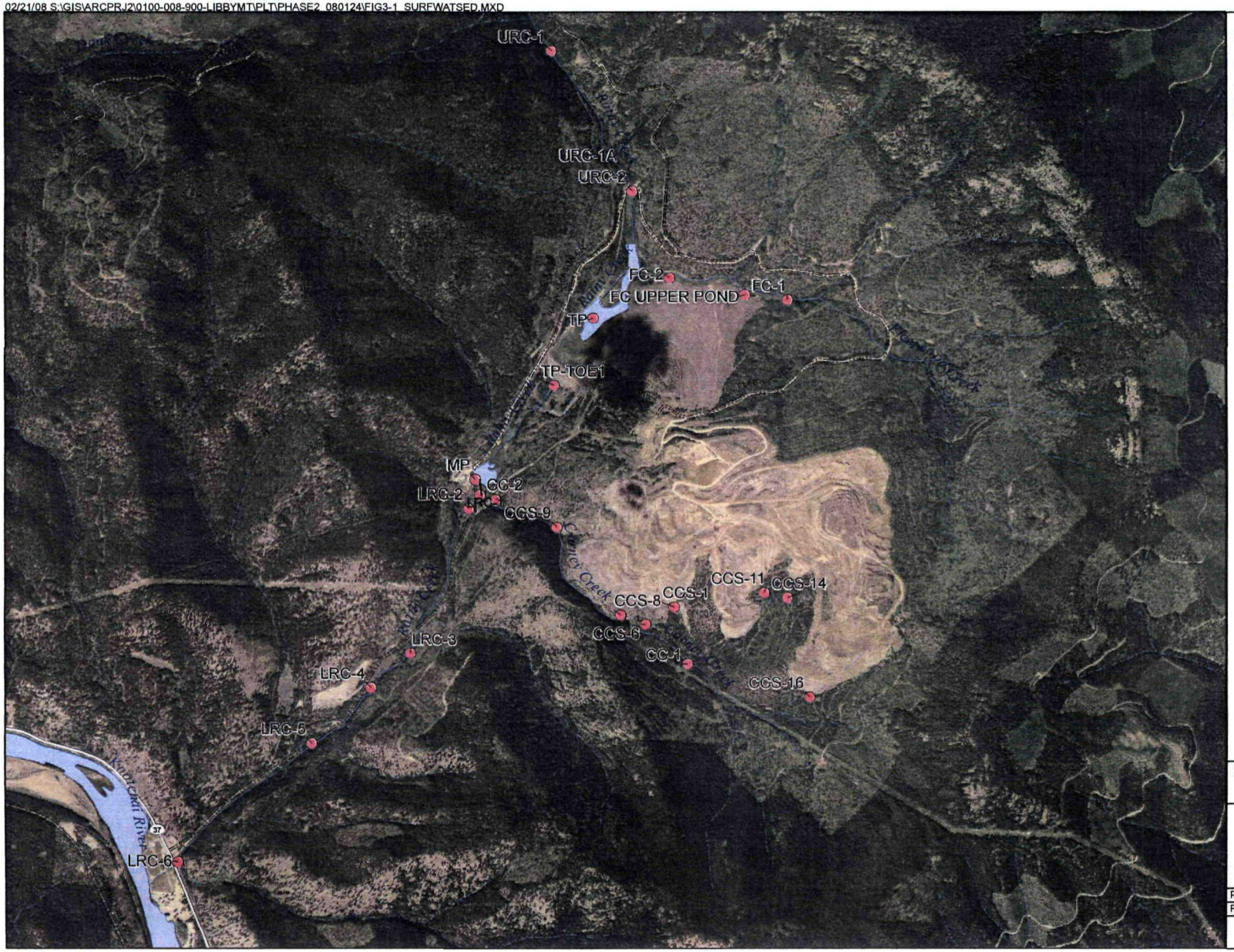
Libby Montana Superfund Site
OPERABLE UNIT 3

FIGURE 2-2
SPRING RUNOFF HYDROGRAPHS

PRJ: 0100-008-900	DATE: February 20, 2008	
REV: 1	BY: JPJ	CHK: KJT

NEWFIELDS

02/21/08 S:\GIS\ARCPRJ2\0100-008-900-LIBBYMT\PLT\PHASE2_080124\FIG3-1_SURFWATSED.MXD



Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream
- Surface Water/Sediment Sampling Location

N

0 2,000 4,000

Feet

LIBBY MONTANA SUPERFUND SITE

OPERABLE UNIT 3

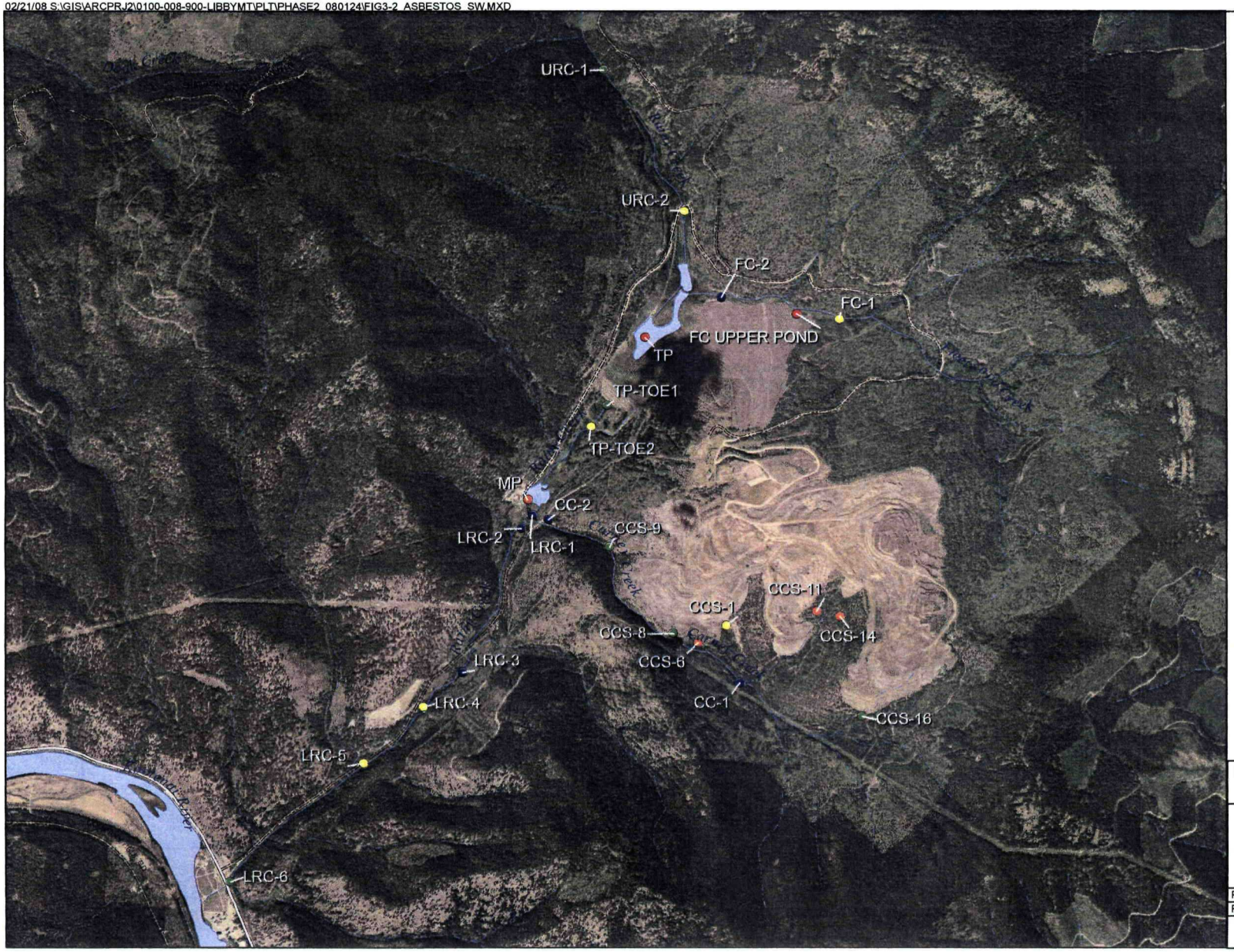
FIGURE 3-1

SURFACE WATER / SEDIMENT SAMPLING LOCATIONS

PROJECT: 0100-008-900	FEB 21, 2008	
REV: 0	BY: CRL	CHECKED: ACK

NEW FIELDS

02/21/08 S:\GIS\ARCPRJ2\0100-008-900-LIBBYMT\PLT\PHASE2_080124\FIG3-2_ASBESTOS_SW.MXD



Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream

Asbestos in Surface Water (Total LA)

- Non Detect
- > ND - 1 MFL
- 1 - 10 MFL
- 10 - 100 MFL
- > 100 MFL

N

0 2,000 4,000

Feet

LIBBY MONTANA SUPERFUND SITE

OPERABLE UNIT 3

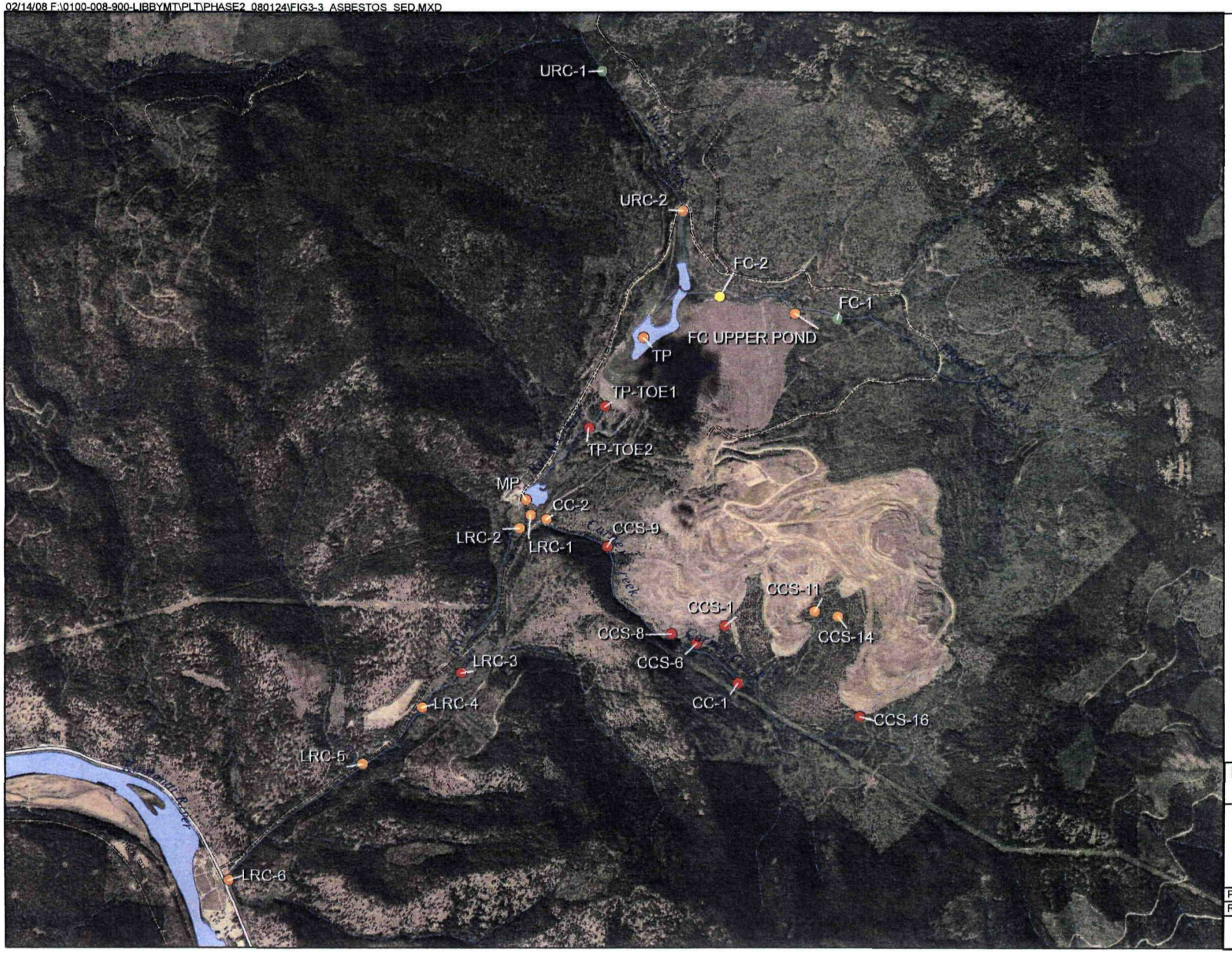
FIGURE 3-2

ASBESTOS LEVELS IN SURFACE WATER

PROJECT: 0100-008-900	FEB 21, 2008	
REV: 0	BY: VFS	CHECKED: KJT

NEW FIELDS

02/14/08 F:\0100-008-900-LIBBYMT\PLT\PHASE2_080124\FIG3-3_ASBESTOS_SED.MXD



Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream

Asbestos Levels in Sediment (PLM-VE)

- ND
- B1 (TR)
- B2 (<1%)
- C (2 - 6%)

N

0 2,000 4,000

Feet

LIBBY MONTANA SUPERFUND SITE

OPERABLE UNIT 3

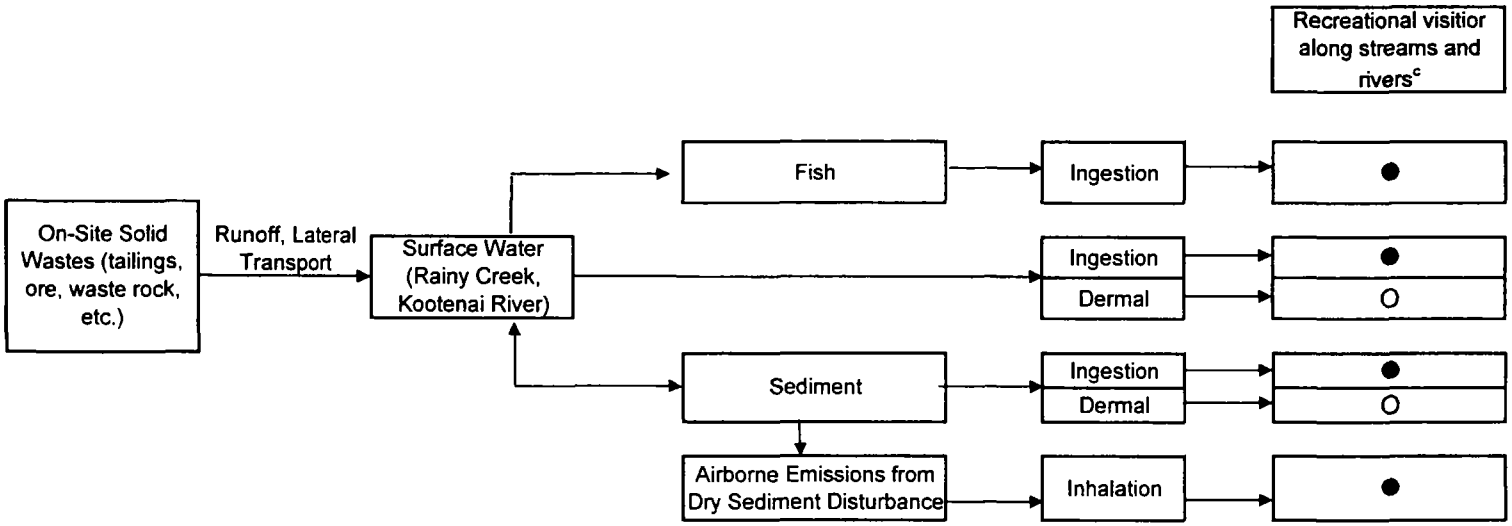
FIGURE 3-3

ASBESTOS LEVELS IN SEDIMENT

PROJECT: 0100-008-900	FEB 14, 2008	
REV: 0	BY: VFS	CHECKED: KJT

NEW FIELDS

Figure 4-1. Site Conceptual Model for Human Exposure to Surface Water and Sediment



LEGEND

●	Pathway is complete and exposure may be significant; quantitative evaluation is warranted
O	Pathway is complete but is believed to be minor in comparison to other pathways; qualitative evaluation is warranted
	Pathway is incomplete or believed to be negligible; further evaluation is not warranted

NOTES:

a. Recreational visitors in forrest areas may include a range of activities, such as camping, hiking, dirt bike or ATV riding, hunting, etc.
b. Woodcutting may include exposures of area residents gathering wood for personal use as well as commercial logging activities
c. Recreational visitors along streams and rivers may include a range of activities such as hiking, fishing and wading/swimming

Figure 4-2. Conceptual Site Model for Ecological Exposure to Surface Water and Sediment

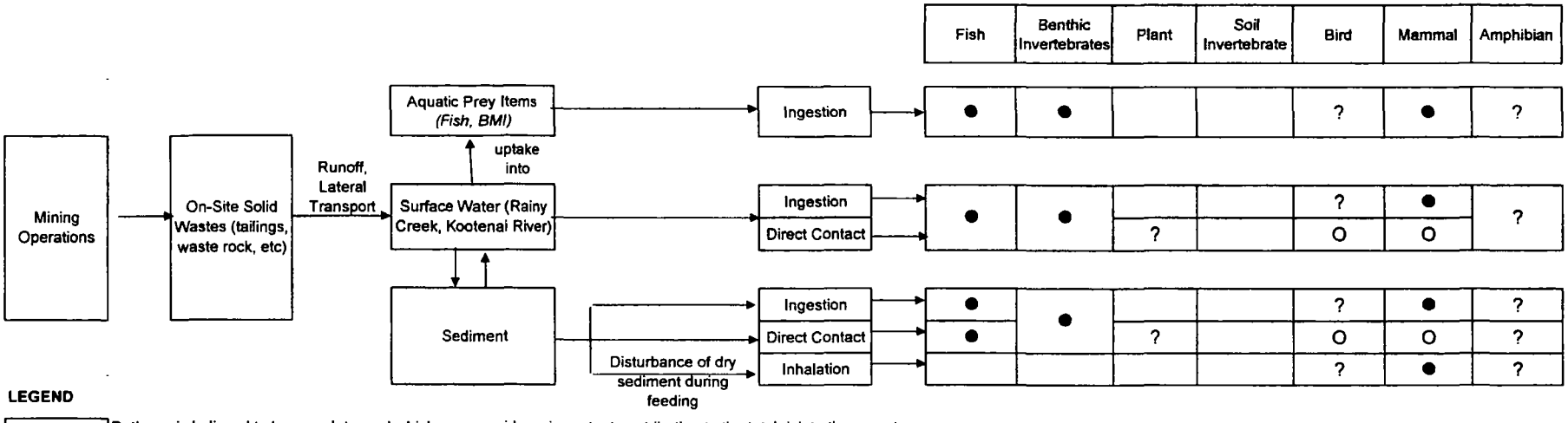
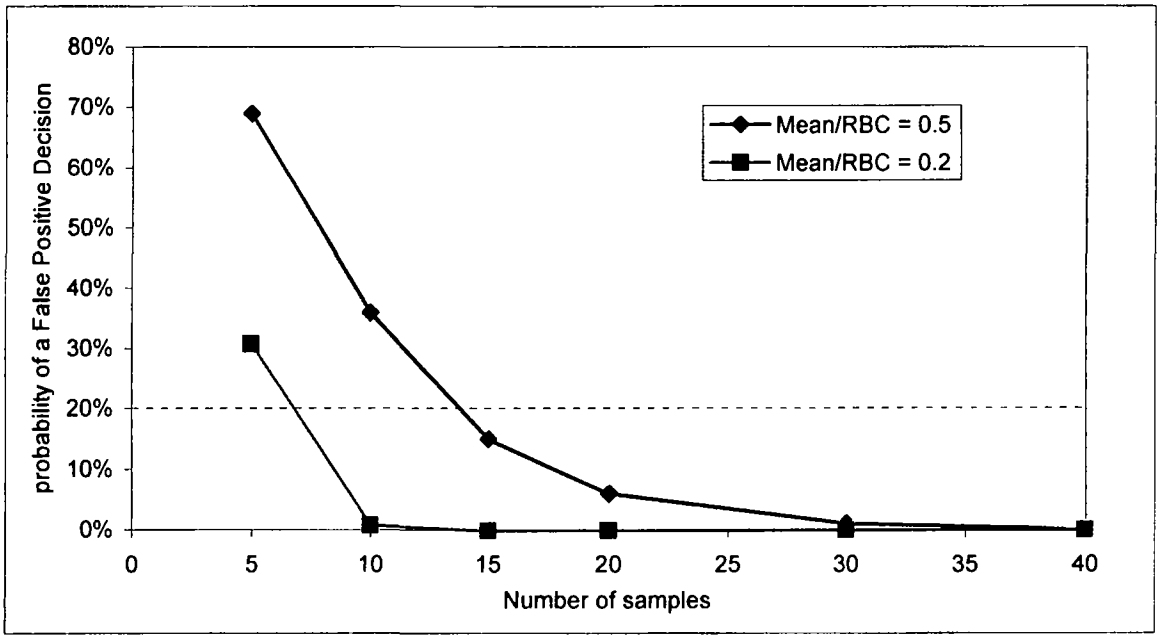


FIGURE 4-3. EFFECT OF SAMPLE SIZE FOR NON-ASBESTOS ANALYTES ON FALSE-POSITIVE DECISION ERROR RATE

Panel A: GSD = 2



Panel B: GSD = 3

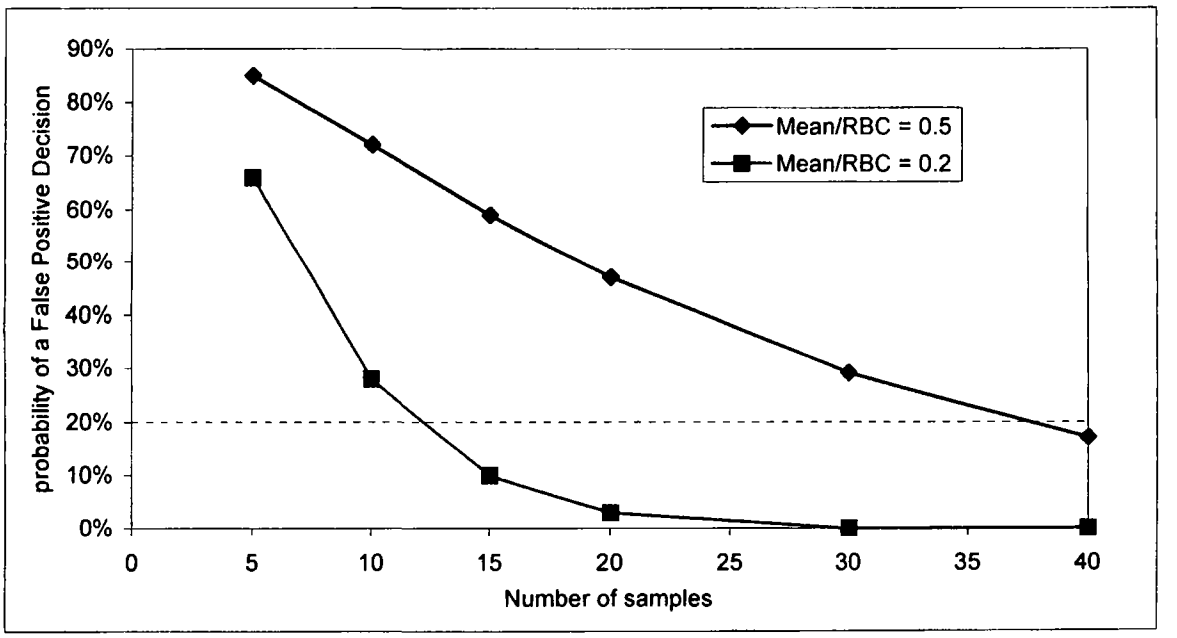


Fig 4-3.xls

FIGURE 4-4. EFFECT OF SAMPLE SIZE ON
VARIABILITY IN OBSERVED MEAN OF ASBESTOS CONCENTRATION VALUES

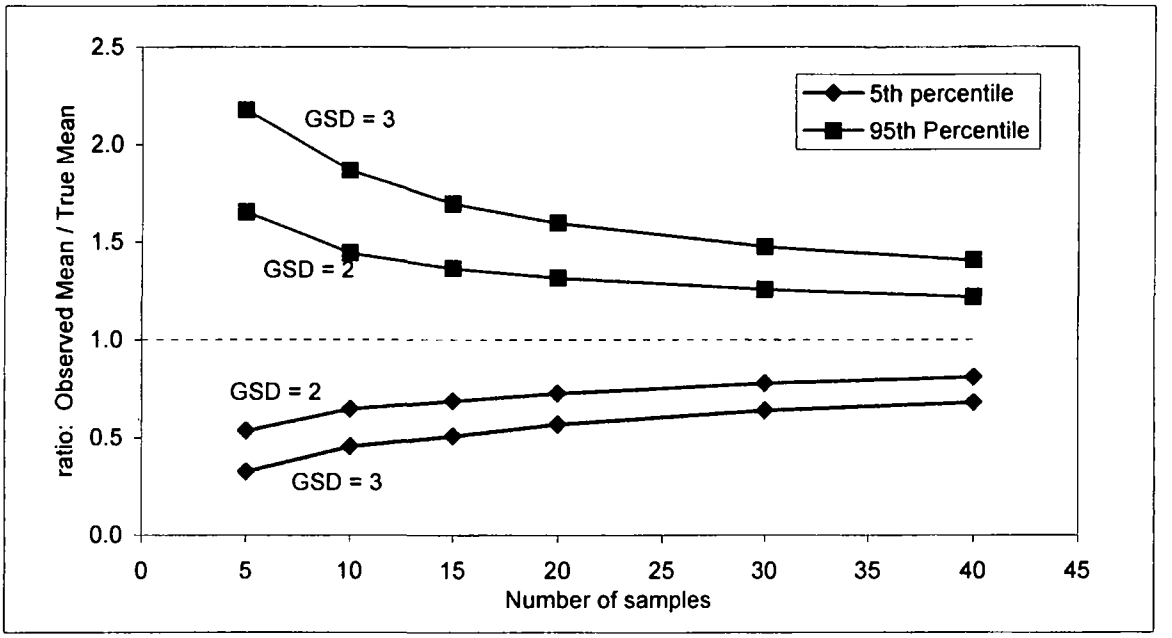


Fig 4-4.xls

02/15/08 F:\0100-008-900-LIBBYMT\PLT\PHASE2_080124\FIG5-1_SAMPLING_LOCNS.MXD

LIBBY MONTANA SUPERFUND SITE
OPERABLE UNIT 3

FIGURE 5-1

PHASE IIA: SAMPLING LOCATIONS IN RAINY CREEK WATERSHED ELEMENT 1

PROJECT: 0100-008-900	JAN. 29, 2008	
REV: 0	BY: VFS	CHECKED: ACK

NEW FIELDS

02/21/08 S:\GIS\arcprj2\0100-008-900-LibbyMT\plt\Phase2_080124\Fig5-2_TailPondSampPlan.mxd

Legend

- Open Water
- Water Diversion
- Perennial Stream
- Intermittent Stream
- Mined Area
- Tailings Impoundment
- Sample Location

N

Feet

0 800 1,600

LIBBY MONTANA SUPERFUND SITE

OPERABLE UNIT 3

FIGURE 5-2

SEDIMENT SAMPLING PLAN FOR IMPOUNDMENT, RAINY CREEK WATERSHED - ELEMENT 1

PRJ: 0100-008-900	Feb 21, 2008	
REV: 0	BY: CRL	CHECKED: KJT

NEWFIELDS

APR 3, 2008 F:\0100-008-900-LIBBYMT\PLT\PHASE2_080318\FIG5-3_SURF_WAT_MON_LOC.MXD

Legend

- County Road
- Primary Road
- Open Water
- Perennial Stream
- Intermittent Stream
- Surface Water Monitoring Location

0 0.25 0.5

Miles

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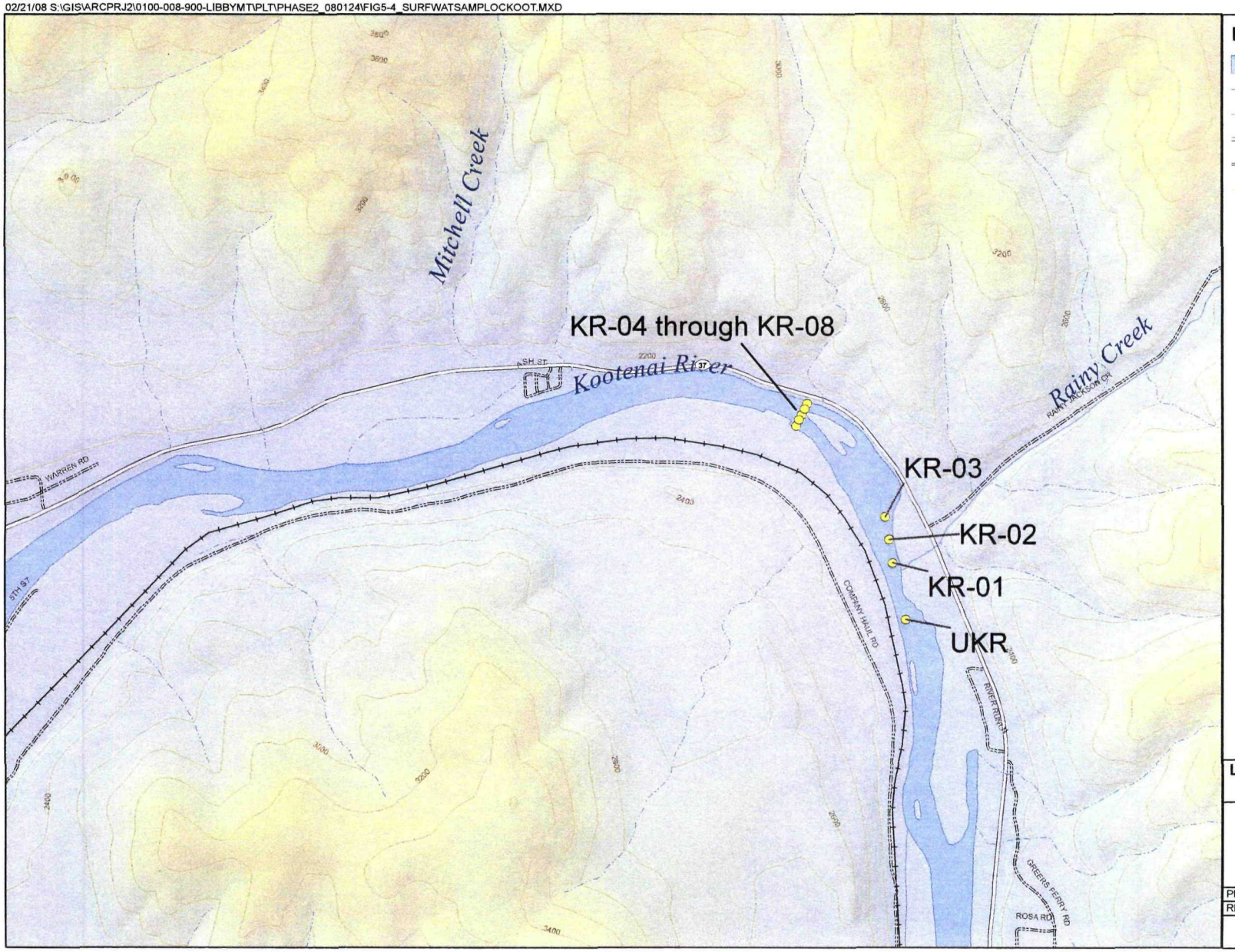
FIGURE 5-3

SURFACE WATER MONITORING LOCATIONS - ELEMENT 2 RAINY CREEK WATERSHED

PROJECT: 0100-008-900	APR 3, 2008	
REV: 0	BY: VFS	CHECKED: ACK

NEWFIELDS

02/21/08 S:\GIS\ARCPRJ2\0100-008-900-LIBBYMT\PLT\PHASE2_080124\FIG5-4_SURFWATSAMPLOCKOOT.MXD



Legend

- Open Water
- Perennial Stream
- Intermittent Stream
- Primary Road
- County Road
- 200ft Index Contour
- Surface Water Monitoring Locations

N

Feet

0 1,500 3,000

LIBBY MONTANA SUPERFUND SITE

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FIGURE 5-4

SURFACE WATER SAMPLING LOCATIONS - KOOTENAI RIVER

PROJECT: 0100-008-900	FEB 21, 2008	
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NEWFIELDS

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 1075492

SITE NAME: LIBBY ASBESTOS

DOCUMENT DATE: 05/29/2008

DOCUMENT NOT SCANNED

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DOCUMENT DESCRIPTION:

1 CD - PART A: SURFACE WATER AND SEDIMENT,
ATTACHMENTS A-D

Contact the Superfund Records Center to view available document.
(303) 312-6473